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And the Ocean Came Up On Land: Perceptions of Adaptive Capacity of Cattle Ranching in Vermilion Parish, Louisiana

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And the Ocean Came Up On Land: Perceptions of Adaptive Capacity of Cattle Ranching in Vermilion Parish, Louisiana

by

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Thesis

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degrees of

Master of Science in Community and Regional Planning

Master of Science in Sustainable Design

The University of Texas at Austin

May 2013

Dedication

I would like to dedicate this to the foxes and birds, land and ocean, and all the cowboys out there, still living off the land.

Acknowledgements

I would like to thank, individually and immensely all of the people who, wittingly or unwittingly put me on this path or supported me along the way. I do not (cannot?) do anything alone – each decision, big or small, that I make is part of a larger understanding about the world. It is an understanding shaped by the people in my life and the things that I do, and has put me exactly where I am today. And for that I am grateful.

I would especially like to thank my mother, who sends me out into the world seeking adventure. She never sends me empty handed; rather, she arms me with love, understanding, patience, curiosity, and a home to come back to. I would also like to thank my father and step-mother Bliss, who have encouraged and supported me throughout this process, mailing me coffee when I ran out and providing a warm home and loving words when I just could not think about school any longer.

There are a handful of exceptional friends that have seen me through this process. EB, Jessie, Beth, Susan, Katie, and Jared – you have done more for me than just listen to my complaints and stay awake while I finish my work. You have shown me love and friendship, and a commitment to fun amidst the chaos. That is important.

I would like to also show my appreciation and thanks to my professors and colleagues here at UT Austin School of Architecture. In particular, I think about the dozens of meetings and long discussions that I had with Dr. Steven Moore. These have significantly shaped my view of the world and my role within it. Finally, I would like to extend my thanks to Dr. Sarah Dooling, who has served as a mentor to me since I met her. She has talked me through countless frameworks and has challenged me, always, to do better, think deeper, and re-conceptualize often.

Abstract

And the Ocean Came Up On Land: Perceptions of Adaptive Capacity of Cattle Ranching in Vermilion Parish, Louisiana

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Cattle ranching in Vermilion Parish is a social-techno-ecological system (STES) that is currently vulnerable due to changing social, technological and ecological conditions. In addressing ways to increase the adaptive capacity of cattle ranching in Vermilion Parish, I used a multiple, mixed method approach grounded in a critical constructivist framework. Constructivism is the idea that our relationship to facts is constructed by our social context. It is these perceptions that shape people's actions. By looking at these perceptions through an emancipatory frame I was able to understand multiple interpretations of meaning, consciously address them, consider how they may have shaped our actions, and then alter those meanings and power relationships. In an effort to increase the adaptive capacity of cattle ranching in Vermilion Parish, my research focused on actions, why people perform those actions, and how to change them.

This research connected the physical landscape of the marshes, the individual landscape of perception, and the conceptual landscape of resilience. If resilience is the

ability of a system (cattle ranching in vermilion parish) to recover after a disturbance, adaptive capacity is when the actors within the system can influence that system's resilience.

I explored the history of cattle ranching in Vermilion Parish from three different, but overlapping perspectives – environmental, social, and technological. These perspectives compliment the information from interviews and 3CM sessions. These 15 interviews revealed the perception of 11 types of threats facing cattle ranching in Vermilion Parish.

The body of literature surrounding resilience theory identifies traits of highly adaptive systems. The recommendations and suggestions outlined in Chapter 6 exist at the intersection of the actors' perception of specific threats and the decidedly generalized traits of highly adaptive systems. These suggestions were geared towards increasing the adaptive capacity of cattle ranching in Vermilion Parish. Given these layered landscapes and their complexity, my recommendations were subject to feedback loops and long periods of integration. These recommendations contribute to the theoretical foundation detailed in Chapter 3 by identifying specific ways that the actors of this particular system may be able increase their own adaptive capacity.

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Chapter 1: Defining the Problem and Breaking it Down

The coast of southwest Louisiana is the home to people from French, Native American, Spanish, African, Caribbean, Mexican, and British backgrounds. It is a place mythologized and storied; a place where many people make their living off the land. In this land of transition between land and Gulf, people are shaped by the place that they live, and in turn influence the natural world around them.

Vermilion Parish is located in the southwestern part of the state, on the northern rim of Gulf of Mexico. The combination of the warm, wet climate, coastal marshes and unique geomorphology (discussed further in Chapter 4) produced a region rich with opportunity for fishing, growing rice, raising crawfish, and grazing cattle as well as oil and gas exploration. While this location on the Gulf of Mexico has allowed multiple types of social and economic development, it has also made Vermilion Parish vulnerable to natural disruptions such as hurricanes and floods.

As I will discuss in greater detail in Chapter 4, the coastal marshes of Vermilion Parish evolved thousands of years ago alongside early Native American people. The region has long been characterized by regular fires and grazing animals. For this reason, the fires and grazing associated with present-day cattle ranching techniques are one way that the coastal eco-systems remain stable. They are therefore a key component of long-term health of the marshes.

Over the span of this research, I have seen that ranchers value their work not only as a way to earn money, but as a way of life – an opportunity to be a steward of the land, be their own boss, and work outside. Coastal Louisiana is a variable and complex landscapes, and many ranchers possess local ecological knowledge that can complement scientific knowledge and contribute to coastal restoration goals. These values represent a

willingness to preserve more than just their profit margin. In fact, many of the ranchers I spoke with were interested in taking actions that they believe will enhance the ecological processes on which they, their cattle, and the marsh ecosystems all depend.

Due to changing social, technological and ecological conditions, the practice of cattle ranching in Vermilion Parish currently exists in a state of vulnerability. While resilience means the ability of a system to recover after a disturbance, adaptive capacity means the ability for the actors in the system to influence the resiliency of that system. The goal of this research is to identify current perceptions of adaptive capacity of cattle ranching in vermilion parish and discuss ways to increase it.

INTRO AND RESEARCH QUESTION

What are some of the current perceptions of the adaptive capacity of cattle ranching in Vermilion Parish, Louisiana? Where and in what way do those perceptions overlap, and why do they matter?

For the purposes of this research, I will briefly define adaptive capacity as the ability of the actors in a system to affect the system, especially regarding the trajectory and overall resilience of the system. I will discuss these ideas more towards the middle of this chapter, and go over them in great detail in Chapter 3: *Resilience Theory*. Additionally, though at one point there were a significant number of dairy farms in the northern part of Vermilion Parish in addition to the beef farms throughout the entire Parish, my concern in this research is solely with cattle ranching for beef production. I explored the perceptions of both cattle ranchers and non-cattle ranchers regarding the cattle ranching industry. While the research focused on those who are ranchers, non-ranchers who are experts in some aspect of cattle ranching were included.

AN ARGUMENT FOR STUDYING REGIONALISM AND CATTLE RANCHING

I consider this research, similar to anthropologist William R. Ferris definition of regionalism, as the study of the relationship between people and the places in which they reside (Gomez, 1998). Ferries goes on to say that this type of study can be approached from the outside, as an anthropologist might, from the inside, as a provincial writer might, or from both perspectives, as a geographer may attempt. The importance of the insider's viewpoint cannot be overstated: people are a significant force in shaping a landscape and their perceptions of that place are a vital component in determining how they shape it. My hope is that this research will be able to incorporate multiple types of knowledge – the intimate knowledge of the land that I will glean from interviews and conceptual cognitive content mapping sessions and well as the geographical aspects of mapping and the historical perspective gained from the archives. These multiple and mixed methods will be discussed in more detail in Chapter Two.

"Every event takes place within a specific context that includes historical, cultural, biological, and economic components" (Gomez, 1998). This explicit acknowledgement of context offers us an important opportunity to delve into the culture and environment of the Louisiana Gulf Coast through cattle ranching. My search for understanding this context has led me to the offices of the Vermilion Parish Chamber of Commerce, the desks of the UL professors, and the kitchen tables of many ranchers. I have learned that each of these people has a particular perspective that values and privileges certain components, and leads to a varied understanding of what goes in the cattle ranching world and why. Each of these is a reality that contributes to the whole, and the whole cannot be understood without these different perspectives.

Regionalism, or the idea of "place" as a contributing factor to planning and design, and a force to be reckoned with, has informed the basis of my research. Architect

Vincent Canizaro, in his chapter in *Pragmatic Sustainability* (Moore, 2011), argues that sustainable architecture and planning materializes the relationship between human and non-human by physically constructing the life enhancing things that communities require. Because these requirements change depending on their context, a regionalist perspective has the tools to address the unique needs of each place.

Along this same vein, in describing his land ethic, naturalist Aldo Leopold wrote: "…the individual is a member of a community of interdependent parts. The land ethic … enlarges the boundaries of the community to include soils, waters, plants and animals, or collectively the land" (Leopold, 1949). This idea of community as a series of interdependent parts, that the community includes a physical place, and where both biotic and abiotic components are meaningful contributors to the whole is a regionalist perspective that I draw on in the formation and exploration of my thesis question.

In asking the question about perceptions of cattle ranching in Vermilion Parish, we must also ask what larger framework or picture this question resides within. In answering this, I turned to Gay Gomez, author of 1998 book *A Wetland Biography* and *The Louisiana Coast,* was someone I referenced frequently while composing this thesis. Gomez, uses two quotes from well-known authors, which help explain my sentiments regarding the bigger picture: one by Wendell Berry, a philosopher, naturalist and agriculturist; and the next by Barry Lopez, a nature writer. Wendell Berry writes that "Without a complex knowledge of one's place, and without the faithfulness to one's place on which such knowledge depends, it is inevitable that the place will be used carelessly, and eventually destroyed" (Berry, 1972). The cattlemen and ranchers of the Cheniers are intimately familiar with the complex workings of the marshes, the ebb and flow of the salt, and the cycles of grasses that spring from the freshly burned marshes. If these cattlemen retreat from the coastal marshes, and rely instead on the urban

opportunities of Abbeville or Lafayette, or depend on the exploitive oil and gas industry along the Intracoastal Waterway, that is when the marshes of southwestern Louisiana may be passed over in the political negotiations of coastal restoration.

Writer Barry Lopez's declaration that "The more superficial a society's knowledge of the real dimensions of the land it occupies becomes, the more vulnerable the land is to exploitation, to manipulation for short-term gain," as cited by Gomez in *Wetland Biography* (1998), reflects this idea that a working coastline is a noticed coastline. The cattle ranching traditions have resulted in a type of stewardship of community, a community which includes the people, the land, and the economy, and all of the flora and fauna in between.

WHY VERMILION PARISH?

The coastline of Louisiana is dynamic, with geologic processes defining the curve of the shore over the course of a person's lifetime rather than the incremental change over extended geologic time. Southern Louisiana is broadly divided into east and west, with the eastern potion considered the bird's foot, or delta, and the western shoreline defined by the Cheniers (Gomez, 1998). A Chenier is a long narrow ridge that runs parallel to the coastline. These ridges are typically about 10 feet higher than the surrounding marshes. Vermilion Parish sits just west of this division – to the east of where the Vermilion River feeds into Vermilion Bay is Deltaic Plain, as illustrated by Figure 1, below. To the west are the Cheniers. It is these Cheniers that provide grazing land for cattle, a higher refuge from the marsh on either side. These Cheniers are comprised of long, narrow tree covered ridges – right around 10 ft high, close to 100 miles long, and, collectively, 20

miles wide in places – that run parallel to the coastline. The stretch from Vermilion Bay to Sabine Lake on the Texas-Louisiana border (Gomez, 1998). "While the ridges give the Chenier Plain its name, it is the combination of people and places that gives the region its character and identity. Understanding the region, then, means understanding the nature and relevance of this intrinsic union" (Gomez, 1998). This interaction of people, the things that people create, and the places where people reside have resulted in the unique landscapes and traditions of southwestern Louisiana.

Figure 1, below, provides a visual context of these landforms. The Mississippi River Chenier Plain stretches 125 miles from Sabine Pass, Texas, to Southwest Point, Louisiana and ranges between 12 to 20 miles wide, with elevations of 6 to 20 ft above mean sea level (Penland and Suter, 1969).

Figure 1: Geomorphological Context Map.

The Deltaic Coastal Marshes are in the southeastern portion of the state and the Chenier Plains are in the southwestern part. These landforms are separated by Vermilion Bay in the center. Source: GIS data set: US EPA. (2012). Level IV Ecoregions of Louisiana. U.S. EPA Office of Research and Development (ORD) - National Health and Environmental Effects Research Laboratory (NHEERL). Retrieved from ftp://ftp.epa.gov/wed/ecoregions/la/la_eco_l4.zip; http://edg.epa.gov. Map by Danica Adams

In resilience theory, on which I will draw heavily throughout this thesis, the boundaries of the system create the structure of the inquiry at hand (resalliance.org, 2001). Resilience theory is a body of literature surrounding the concept of socio-techno-ecological systems. It discusses the ability of a system to tolerate a disturbance and rebuild itself if necessary (resalliance.org, 2001). Adaptive capacity, or ability of a system to adapt to changing conditions and still maintain its basic functions and identity, is the hallmark of resilience (resalliance.org, 2001). Rivers flow into Vermilion Parish from other places, calves go to auction in other parts of the country, and salt water infiltrates for local, regional and global reasons. However, for the purposes of this research I will use the politically distinct Vermilion Parish to define the social, ecological and economic boundaries. Although many social, ecological, and economic processes extend far beyond the parish lines, others do not. The system itself is the system of cattle ranching within Vermilion Parish.

Throughout history, Vermilion Parish has repeatedly experienced severe hurricanes and flooding. Since Hurricanes Katrina and Rita slammed south Louisiana in 2005, millions of dollars and countless man-hours have been spent helping affected communities regain their footing. Since then, local, state and national governments have increasingly recognized the need for resilient communities and healthy ecosystems. In 2011, the Vermilion Parish police jury (similar in structure to a City or County Council found elsewhere) voted to take advantage of a national program designed to encourage local resiliency planning. A Police Jury is a parish-wide governing body whose members are elected by parish residents. There is currently, in 2012 and 2013, a parish-wide resiliency planning process underway, with Lafayette communications firm Sides and Associates taking the lead. The goal of this resiliency planning effort is to create a

parish-wide resilience plan that would be help Vermilion Parish withstand the detrimental effects associated with hurricanes and other similar natural disasters.

What does Vermilion Parish have that other places do not? How do the cattle ranching traditions adapt or change in response to new circumstances or new information? These questions are the driving force behind my research, begging for attention. And so I chose Vermilion Parish not only for its unique social systems and intriguing geography coinciding conveniently with neatly delineated political boundaries, but also because I have resources there. In this type of research, resources come in the form of social networks, familiarity with the roads and the landscape, and access to places to sleep, eat, and transcribe hours upon hours of interviews. They can mean the difference between two months and two years needed to do field work or between robust and meager data sets.

WHY PERCEPTIONS?

The question of why I chose to examine *perceptions* of adaptive capacity rather than absolute adaptive capacity will be explained in greater detail in Chapter 2, *Theoretical Foundation of Inquiry*. However, to introduce the topic, we should begin with a discussion of Socio-Techno-Ecological Systems, or STES, as described in the body of literature on resilience theory. Walker and Gunderson, et al. (2006) use the phrase 'coupled Social-Ecological-Systems,' or SES, to mean an emergent system. This means neither humans embedded in an ecological system, nor ecosystems embedded in human systems; rather a different thing altogether (Walker et al. 2006). STES takes that same concept further by integrating an explicit acknowledgement of technology into the definition. In the preface of *The Social Shaping of Technology* (2010), MacKenzie and Wajcman define technology as the things that people have made, our knowledge of those

things and the human practices that engage those things. It is these things that feed, clothe and shelter us, as well as provide comforts and entertainment (MacKenzie and Wajcman, 2010).

When considering the Vermilion Parish, for example, one may say that the residents have helped shape the form and function of the ecosystem. To a large degree, the ecosystem has been shaped by technologies such as canals, levees – technologies that were implemented in response to perceptions of the environment. As well, one may say that the ecosystem and those technologies have helped shape the form and function of the social system within it. In this way, the Gulf Coast may be considered a socio-techno-ecological system.

Individual and collective action determines the nature and extent of these emergent forms. The transformation of marsh and prairie to agricultural land was the result not of one governmental decree, but of hundreds of small individual decisions, each resulting in landcover change on a small piece of land. These individual decisions were driven by perceptions of cost, benefit, risk and vulnerability. When one landowner puts fences around his property, he is responding to a perception of risk and potential benefit.

Since these individual perceptions are what lead to individual and collective action, or the creation of our present reality, if we are to affect change, we must first understand what these perceptions are, who holds them, and why.

WHY ADAPTIVE CAPACITY?

Adaptive capacity is part of the larger discussion of resilience ecology, which has evolved somewhat since C.S. Holling first applied the concept of resilience and alternate stable states in his paper "Resilience and Stability of Ecological Systems" (Holling

1973). Adaptive capacity is how well the actors in the system can determine the resilience and trajectory of the system they are acting within. In this 1973 article, resilience was stated to be one of the defining characteristics of an ecological system. The definition of resilience as the capacity of a social ecological system to *absorb disturbance* and *reorganize while undergoing change* so as to retain essentially the same function, structure, identity, and feedbacks is one widely used by scholars such as Brian Walker and Carl Folke, members of the Resilience Alliance (resalliance.org, 2001). To continue the example from above, a resilient marsh would be able to still function as a marsh – it would have both interior and edge habitat suitable for a wide variety of species and there would be significant nutrient cycling and carbon sequestration using grass, among other functions – even if occasional patches are transformed for other uses.

In this context, resilience can refer to the capacity of linked social-ecological systems to absorb recurrent disturbances such as hurricanes or floods so as to retain essential structures, processes, and feedbacks. It reflects the degree to which a system is capable of self organization (in contrast with no organization or an externally imposed organization) and the degree to which the system can learn or adapt to changing circumstances (resalliance.org, 2001). In this same marsh, for example, if canals are dredged and, because of that, land management is required in order for the marsh to continue to support the same species, its ability to self organize has decreased.

Adaptive capacity, then, would be the ability of a system – in this case, cattle ranching in Vermilion Parish – to adapt to and shape changing circumstances while still retaining its fundamental functions as a system.

> Systems with high adaptive capacity are able to re-configure themselves without significant declines in crucial functions in relation to primary productivity, hydrological cycles, social relations and economic prosperity. A consequence of a loss of resilience, and therefore of adaptive capacity, is loss of opportunity,

> constrained options during periods of re-organisation and renewal, an inability of the system to do different things. And the effect of this is for the social-ecological system to emerge from such a period along an undesirable trajectory. (resalliance.org, 2001)

An analysis of the adaptive capacity of cattle ranching will necessarily touch on social, environmental, and economic concerns within Vermilion Parish.

A SITUATED PERSPECTIVE

When I began the process of determining and defining my research question, I kept finding myself looking towards the Gulf Coast. I wanted to explore the intersection of human, technological and ecological systems; understand ways in which this overlap could produce something greater, healthier and more resilient than each system alone. I wanted, in essence, to look at the socio-techno-ecological systems along the Gulf Coast.

As I narrowed my area of interest from the entire Louisiana Gulf Coast to Vermilion Parish, I also narrowed my topic from the very broad "coastal resiliency" to the much more specific "cattle ranching." I eventually decided that I wanted to research perceptions of adaptive capacity of cattle ranching. However, during my first round of interviews I still thought of it as "Ways that the Gulf Coast Affects Cattle Ranching" instead of "Perceptions of Adaptive Capacity of Cattle Ranching." This is reflected in the wording of some of my questions during the first two or three interviews that I conducted. For instance, instead of asking what factors affect the *adaptive capacity* of cattle ranching, I ask how the *coast* affects cattle ranching. Embedded in this was the assumption that coastal process would be the most significant, and that a conversation about ranching would necessarily be about coastal processes. While going through the process of reflecting on each interview and preparing for the next, I revised and honed my perspective. Now, in the final stages of information synthesis, I have realized that, yes, questions about the marshes are indeed questions about ranching, and vice versa.

WHICH WAY NEXT?

The next two chapters will describe the framework I used in theorizing my question of adaptive capacity. Chapter 2 will go into great detail regarding my system of inquiry, or the way that I approach the problem; Chapter 3 will explore resilience theory and how it relates to cattle ranching in Vermilion Parish. I will present the history and background of cattle ranching in Vermilion Parish from three different perspectives in Chapter 4, and in Chapter 5 I will lay out my findings. My synthesis, analysis and recommendations take place in Chapter 6.

Chapter 2: System of Inquiry and Methodology

SYSTEM OF INQUIRY: CRITICAL CONSTRUCTIVISM

The physical existence of a thing or animal and its particular arrangement of molecules may be indisputable, whether that thing is yet undiscovered or exists in downtown New Orleans. It is the meaning, however, that is associated with each of these particular arrangements of molecules that can and will be (rightfully) disputed. The ontological premise of this thesis is that, as Rorty stated, "the world is out there, but descriptions of the world are not" (Brand, 2003).[1] He suggests that there is a "distinction between the claim that the world is out there and the claim that truth is out there" (Brand, 2003).[2] Indeed, it is these social meanings that prompt some to use the words "contested" and "truth" together. In the search to understand cattle ranching in Vermilion Parish, knowing cattle ranching statistics is not enough to understand the cattle farmers themselves, what they are up against, or how they might handle challenges. Ranching has as many manifestations as there are ranchers, and each of the ranchers, agricultural extension agents, and Wildlife and Fisheries agents distinguish capacities and vulnerabilities through the lenses of their own experiences, seeing the same region as differently as they see each herd. To understand cattle ranching in Vermilion Parish, these facts and viewpoints must be synthesized, examined together to reveal the nuances and interplays between their various components.

This set of ideas about the social construction of truth, packaged together, is commonly called constructivism (Lincoln and Guba, 1985). As an epistemological stance, constructivism is way of describing what knowledge is, how to acquire it, and the

[1] While I would like to say that I found this quote during extensive readings of Richard Rorty, in fact I found it while perusing the dissertation of Ralf Gregor Brand, 2003, UT Austin.
[2] As cited by Ralf Gregor Brand, 2003, UT Austin.

extent to which a subject can be known (Groat and Wang, 2001). A constructivist viewpoint, then, would argue that knowledge – that is, not just physical facts themselves, but our relationship to facts, what they mean to us, and how relevant they are – is constructed by our social context (Groat and Wang, 2001). While a fence is a fence, the meaning of the fence is one thing when it is in the middle of St. Charles Avenue in New Orleans and a completely other thing when it is along the road in Vermilion Parish, keeping cattle from roaming. It is a way of analyzing meanings and power relations in a place (James, 1904).

Critical constructivism, to take this idea one step further, would be the desire to not only understand multiple interpretations of meaning, but to consciously address them, allow them to change when needed, and consider how they may have shaped our actions (Kincheloe, 2005). It is a decision to alter those meanings and power relationships in an emancipatory frame (Marx, 1908). So, because a fence in Vermilion Parish plays a different role than a fence in New Orleans, a critical constructivist may consider how our individual interactions with these fences over time– one as an instrument of cattle ranching and one as a crowd control measure during Mardi Gras – have shaped our viewpoints on their role and informed how we build future fences. A critical constructivist would then explore ways to influence these viewpoints in an effort to change the way that fences are built.

In short, this research is based on the idea that while reality is "out there," how we interpret reality will depend on what we already know or how we have already interpreted reality. How we interpret reality will also influence our actions. Therefore, in order to understand people and why they do certain things, I must first understand these perceptions of truth, their interpretation of facts, or their determination of what problems

need to be solved and how to go about doing that. The most effective way to reach these insights is to employ the methods described later in this chapter.

This emphasis on social construction of meaning as the basis for individual action, or how and why people construct facts, led to the development of my thesis question: What are the perceptions of adaptive capacity of cattle ranching in Vermilion Parish? In the case of coastal resiliency, perceptions, or individual statements of truth, can be more powerful than discrete facts. It is these individual interpretations of facts which lead to action, and it is the collection of individual actions that create the techno-social-biophysical reality of our world.

My attitude towards research echoes Gay Gomez in A Wetland Biography (pg 7), when she says that, "to reveal the essence of a place, two things are necessary. The first is knowledge *about* a place, the second, actually *knowing* [the place]" (Gomez, 1998). The fine line that as a researcher I try to walk is to be rooted in theory and armed with maps while experiencing cattle ranching from an insider's perspective.

In this chapter, I will lay the roadmap for how I went about gathering and collecting information, why I used those methods, and then how each of these types of information contributes to a holistic understanding of the adaptive capacity of cattle ranching in Vermilion Parish.

STRATEGIES AND TACTICS EMPLOYED

In judging the quality of research, Groat and Wang (2001) suggest that each system of inquiry requires a particular system of evaluation. I have used those quality standards for data proposed by Egon Guba (Groat and Wang, 2001) for constructivist inquiry: credibility, transferability, dependability, confirmability. Over the duration of this research, I have employed a mixed method approach of gathering data. To devise

this mix of methods, I turned to Architectural Research Methods and A Handbook for Social Science Research by Perecman and Curran (2006). I selected each of the following tactics for its potential contribution to a robust and compelling research design that would assess the current perceptions of vulnerability and adaptive capacity of the cattle industry in Vermilion Parish. The rest of this chapter describes the five tactics I used to gather and interpret data.

I submitted IRB application under expedited review standards and received notice that based on my research methods articulated for human subjects, IRB approval or oversight was not required.

Literature

I explored resilience theory as a way to frame my research question. It was the lens through which I analyzed the current and historical patterns of cattle ranching and interpreted the people and culture of the place. Through resilience theory, I was able to assimilate the physical aspects of place and explore the paths that led to this point in time. It ended up being the meat hook which I hung the flesh of cattle ranching on.

The body of literature associated with resilience theory is vast and multi-faceted. As my research question expanded, contracted, and shifted in focus, my literature research followed suit. I chose new articles to read based on recommendations from Professors, reading through the citations of useful articles, and perusing the library website search results. I read and re-read theory articles throughout the process of gathering and synthesizing data, and as I moved through this process I read with an increasingly knowledgeable eye. While I gathered overarching concepts and ideas from dozens of articles, when I needed concise definitions, I turned to the resilience alliance website: resalliance.org, which provides a glossary of terms used in resilience theory.

I used software called Zotero to manage my sources and citations. To keep track of ideas and my reactions to those ideas, however, I did things the old fashioned way. For each article that I felt was relevant, I printed a copy, highlighted important ideas, and made notes in the margins.

Interviews

I began the process of understanding the cattle ranching culture with traditional open-ended interviews of key informants. Key informants included local industry experts as well as academic and professional specialists. A long-time cattle rancher in Vermilion Parish, for instance, was considered a specialist in cattle ranching in Vermilion Parish; while a restoration expert who has significant expertise was considered a professional specialist. Recruitment of key informants for these interviews and for the 3CM sessions, discussed later, was made, in keeping with the social patterns of rural Louisiana, by tapping my own network of contacts and branching out from there. The interviews were all done in person and all participants gave permission to be recorded on a digital voice recorder.

After I interviewed each respondent, I downloaded the digital audio file onto my laptop and transcribed it. To transcribe the first seven interviews, I used the voice recognition software Dragon Naturally Speaking. Dragon Naturally Speaking can be trained to a person's voice and used to directly transcribe as someone is speaking, or it can be used to transcribe a recorded audio file. Although the Cajun French accents of the respondents prevented Dragon from being able to transcribe the recorded audio files, I was able to train the program to my own voice, then listen to and speak each interview. By re-speaking the interviews for transcription, I became intimately familiar with the content connected to each respondent. For the last eight interviews, I paid a transcriber.

Because the accents of many respondents were difficult to understand, and because the names of places that the respondents were referencing were unusual, I decided that a Louisiana local would be able to do the best job with the best accuracy. I eventually selected a woman that grew up in Lafayette, Louisiana to complete the interview transcriptions.

Once these interviews were transcribed into Microsoft Word, I converted them to text files and used the program HyperResearch to code them. Coding is a process of identifying recurring themes and ideas. For instance, the following passages would include several different codes:

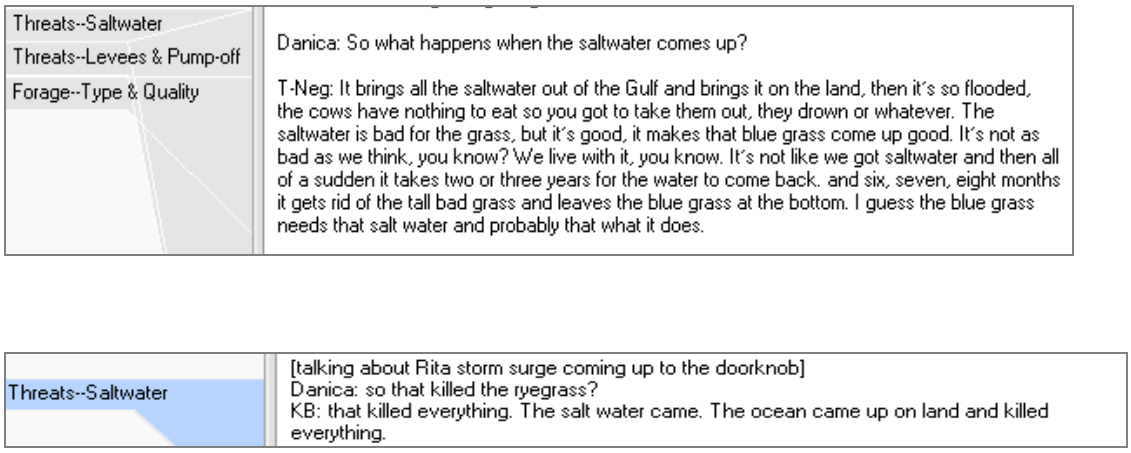


Figure 2: Coding Using Zotero Software

Source: Danica Adams

I ended up with 52 codes in all, which were then grouped into 10 categories, one of which I named threats. During my fifteen interviews with ranchers and other types of experts, they collectively identified eleven specific types of threats and vulnerabilities. Many of these are tightly intertwined or even directly overlap, and all of the participants identified multiple categories of threats over the course of the interview. Some examples

of the other codes and groups that I used are Breeds, Consumers, History and Ways, and Operations, among others.

While these types of threats are topics that emerged from the data, not ones that I prescribed, my own understanding and definitions of them affected the way in which I coded. For example, even though many would say that they are two sides of the same coin, based on the way that people talked about each of them, I chose to make canals and levees two different topics, or codes. Additionally, I made "policy and regulation" one code, when in fact I could have chosen to break it down into several. For instance, canals were only mentioned 38 times and levees were mentioned 50 times. Each time the conversation came around to the topic of levees, I coded it as a discreet instance. If I had combined canals and levees, then as a threat, it may have surpassed "hurricanes," which was mentioned 78 times, in perceived importance. Or, if I counted each person who mentioned a particular theme instead of each time that theme was mentioned, I would come back with a different number. To a large extent, these codes and their definitions reveal some version of my own conceptual model regarding the topic as well as affect the statistics that I can pull from my coding exercises. For that reason, I begin Chapter 5 by defining the codes.

Once all of the interviews were coded, I was able to aggregate the data using HyperResearch. During this stage of analysis, I summed the total number of times that the codes relating to perceived threats were used. For instance, the idea of hurricanes as a potential threat to the practice of cattle ranching came up 78 times, while the idea of policy and regulation as a threat was only mentioned 30 times. The data that I coded as History, Ways, Operations, and Breeds were what I then used to construct parts of the *History and Background* chapter.

3CM sessions

I also collected data using the conceptual content cognitive mapping (3CM) technique developed by Stephen Kaplan and Anne Kearney (Kearney and Kaplan, 1997). The 3CM sessions were used to explore the perspectives of Vermilion Parish cattle ranching stakeholders relating to their perceptions of both vulnerabilities and adaptive capacities of the industry. These included spatial, economic, social, environmental, and political perspectives, as well as a significant component of storytelling and explanations of traditions. Eight of my 15 interview respondents participated in 3CM sessions. The reasons that seven of the respondents did not do 3CM had everything to do with my own limited experience as a researcher. The first several interviews that I conducted, I was nervous about doing the interview and unprepared to take it a step further with a 3CM session. During the second and third round of interviews, I felt more comfortable with the material that we were going over and was at ease with the 3CM process.

The goal of this type of data collection was to allow participants to give voice to complex knowledge structures and to get an in-depth explanation of participant's perceptions regarding spatial, economic, social, or environmental adaptive capacity of the industry within the parish. Typical card sorting techniques will present participants with a set of ideas, concepts, or pictures that the participants are then asked to sort and rank. The 3CM method differs from this by using a combination of interview questions and card sorting to allow the participants to identify, "own," and make connections between pieces of information, or objects. It allows participants to explore and more succinctly discuss their own perceptions of the topic at hand.

During the eight 3CM interviews, participants were asked to identify those concepts that they think are important in explaining their view of cattle ranching in Vermilion Parish. I wrote each of these concepts on a blank note card. They were then

asked to organize these concepts into categories and sort them in such a way that visibly shows how they understand the topic at hand. It is this identification and card sorting and provides a deeper understanding of the structure of participants understanding and perception of cattle ranching in Vermilion Parish.

1. Identification of the factors or aspects of adaptive capacity of cattle ranching that the participant feels is relevant

Over the course of each interview, I wrote down themes or ideas that were recurring or seemed important to the respondent. Towards the end of the interview, I would lay the cards out so the respondent could see each of them and explain that I had written down what seemed to be important ideas during the conversation. I then asked if they would like to add anything or if, in their opinion, what were some important things to consider when talking about the future of cattle ranching in Vermilion Parish? What were some specific things that affect the adaptive capacity of cattle ranching? As they listed each idea, I wrote it on a note card and set it out with the others.

2. Organization of the concepts that the participant has identified

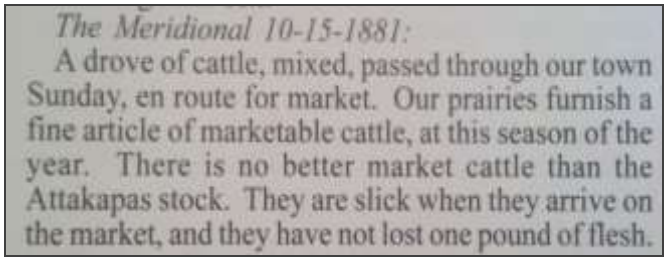
As discussion about the cards took place, I would ask the respondent how to arrange the cards. If they didn't, or if they stopped, then I would arrange them, following their logic. In every instance, the respondent would resume arranging the cards, explaining their logic out loud as they went. Frequently, as they were arranging and explaining, we would end up adding more cards. The final arrangement was always the participants', and they always "signed off" on the arrangement before I took a picture of it.

3. Explanation and labeling of categories – if discrete clusters were formed, the cards will be paper clipped together and participants will be asked to give them a label and short explanation as to why they are grouped together.

If the respondent was not explaining in clear enough fashion why they were grouping the cards the way they were, I would ask "Can you explain to me why you arranged the cards in this particular order?" As they explained their logic out loud, they would often rearrange the cards more, refining their stance. It was these explanations that gave me the most insight into the way each respondent considered the problem.

Archives

To develop a contextual understanding of Vermilion Parish Cattle Ranching I turned to the local archives of Vermilion Parish. I was able to discern several small historical events that collectively formed the historic arc that has led to current conditions. Archival information on cattle ranching is sparse, but I made use of the Vermilion Parish Cultural Center which is located in downtown Abbeville. When I found it in Dec 2012, the cultural center had just removed its display on coastal cowboys in Vermilion Parish – a topic that goes hand-in-hand with ranching. Although I missed the exhibit, I was able to find other resources to draw on. At the Vermilion Parish Cultural Center there was one source in particular that I drew from for information: The History of Vermilion Parish, Louisiana: Part II (2003). It is a compilation by subject of every passage/article in the local newspaper, *The Meridional*, from 1877-1900, as well as stories and passages submitted by current or former residents of the area. In this book, I looked up the subjects "animals" (most of these entries were about either cows or stray dogs and cats) and "Pecan Island." The passages were in the form of short snippets, paragraphs that had been clipped and coded according to their subject area. Figure 3 below is an example of one snippet:



The Meridional 10-15-1881:
A drove of cattle, mixed, passed through our town Sunday, en route for market. Our prairies furnish a fine article of marketable cattle, at this season of the year. There is no better market cattle than the Attakapas stock. They are slick when they arrive on the market, and they have not lost one pound of flesh.

Figure 3: Passage from *The Meridional*, 1881.

> A passage that discusses a "drove of cattle" passing through Abbeville. This was originally published in the local newspaper, still being published today, on October 15, 1881. The passages are arranged by topic; cattle appear in the "animals" section. Source: The History of Vermilion Parish, Louisiana, Volume II

Cattle Brands of Vermilion Parish is a compilation of all of the records of cattle brands in the area. Since the brands are also recorded by race/ethnicity, it is possible to see the expansion and evolution of cattle ranching across cultural groups. I used two newspaper articles that were referenced by the authors to assist me in piecing together the history section of this thesis research.

Maps

Using maps I was able to make explicit several important components of this research, namely the geomorphology of the Cheniers and the interview respondents delineation of threats. All of my GIS data was in the form of rasters or shapefiles, compatible with ArcGIS 10.1. Much of these files were pulled from the US Census, Louisiana Department of Environmental Quality (LDEQ), National Oceanic and Atmospheric Administration (NOAA), Louisiana Department of Transportation and Development (LA DOTD), National Agricultural Statistical Survey (NASS), LSU Agricultural Extension Office, United States Geological Survey (USGS), and the US Fish and Wildlife Service (NWS).

Importantly, I also used GIS to display and analyze the results of my coding exercises. To do this, I first created a new shapefile of Vermilion Parish and manually drew small polygons in the vicinity of each respondent's location. Each respondent's polygon was named using a unique FID number that was later used to join quantitative date to the location. These polygons were used to connect the spatial location of the respondents with the data from their interviews. To do this, I exported aggregate data regarding identified threats from HyperResearch and put it into table format in Microsoft Excel. I then used the *join* tool in ArcGIS to join the data from the table to the polygons, based on the FID field, shown in Table 1 below.

				Cultural				Reg.	Techno-Environmental					Other	
Participant #	Relationship to Cattle Ranching	Size	Location (North or South VP)	**Age**	**Next Generation**	**Money**	**Subdivisions**	**Policy and Regulations**	**Flood and Drought**	**Hurricanes and Storm Surges**	**Saltwater**	**Levees**	**Canals**	**Other**	**Number of Threats Identified**
1 HS	-	-	N												
2 CS	Rancher	Lrg	M												
3 CB	Rancher	Lrg	S												
4 TC	-	-	N												
5 KB	Rancher	Med	M												
6 RS	Rancher	Med	N												
7 AB	Rancher	Med	N												
8 CL	Rancher	Med	M												
9 JH	Rancher	Lrg	N												
10 JL	Rancher	Med	M												
11 TS	Rancher	Lrg	S												
12 DH	Rancher	Lrg	M												
13 JE	-	-	S												
14 AD	-	-	N												
15 PB	-	-	N												
Code frequency:															
Number of respondents															

Table 1: Code Frequency of Identified Threats

This chart, fully fleshed out and explained, appears in Chapter 5: *Findings in Vulnerabilities and Adaptive Capacities*. Source: Danica Adams

Once this shapefile was created, I was able to display each of the threats and analyze the relationship between location and perception of threats or vulnerabilities.

SYNTHESIS AND ANALYSIS

I synthesized these mixed and multiple methods into a coherent story and hypothesis using a circular, incremental, and iterative process. I began my research with some preliminary inquiries into the practice of cattle ranching in southwestern Louisiana. To do this, I turned to a few good books on the subject – the best being *Louisiana Cowboys* (Jones, 2007). Once I had gained some footing in that area, I went to Louisiana and did several interviews. From the information I gleaned from those interviews regarding the ways and means of ranching in the area, I pieced together an initial understanding of the history and background of ranching as well as current operations. From this, I was able to go to the archives and books for more in-depth information. With each successive interview and history book, I came to a more nuanced understanding of the physical process that were taking place in Vermilion Parish, how the livelihood of ranching was carried out, and what people think is happening in Vermilion Parish. This increasingly nuanced understanding contributed to how I conducted subsequent interviews, and thus, what information I got out of each.

By the time I started my second round of interviews, I had finished transcribing the first round and had started coding them. Consequently, during the second round of interviews I was more informed and asked a slightly different set of questions, with a different associated hypothesis. This rotation between interviews, literature or archives, and data aggregation led to a gradual new understanding, or synthesis of information.

When I moved into the writing stage, I analyzed each bit of information through the lens of resilience theory and incorporated that language into my study.

The second stage of research was data analysis. I started out by creating a chart of the coded data and looking for patterns within it. My assumption was that perceptions of threats and vulnerabilities could be linked to a respondent's relationship to cattle ranching, the size of their ranch, or their location relative to the marshes. To address this assumption, I mapped the interview responses using ArcGIS 10.1. These maps are displayed in Chapter 5.

OCCASIONAL CONFLICTS

At times I encountered information from interview respondents that seemed to contradict science. For example, the idea that a tidal cycle could change from a 12 hour cycle to a 4 hour cycle due to coastal land loss and dredged canals seems scientifically difficult. However, multiple respondents referenced the idea that this has happened, and so, in keeping with my investigations about perceptions of truth, I have let it go unquestioned.

There were, at times, contradictory perceptions about what constitutes a threat and why. Most of these are in the environmental category and concern saltwater intrusion. Many respondents regard saltwater as a threat to continued forage availability, however, there are those respondents that say saltwater is not a problem – there has always been saltwater in the area. The real problem, according to some, are the levees that increase rates of subsidence or the canals that allow greater quantities of saltwater to move faster and further than they ever have before. In these cases, my recommendations try to incorporate each of these perceptions of threats, but will ultimately stem from my own beliefs and perceptions of the issue.

SUMMARY OF METHODOLOGY

In this chapter, I argue that the meanings of physical things are frequently disputed – does a levee mean subsidence or does a levee mean protection from salt water? I claim that, in keeping with the constructivist viewpoint, in part, it is the context in which the thing exists that gives those things their meanings. As I will briefly discuss in Chapter 4: *History and Background*, a levee in New Orleans may mean protection from storm surge while a levee in Chenier au Tigre may mean subsidence. These meanings are social in nature, and they differ between social groups as well as between individuals. The meanings of these objects and an individual's perception of truth are related ideas. The "distinction between the claim that the world is out there and the claim that truth is out there" (as cited in Brand, 2003) is an important component of critical constructivist thinking. Indeed, cattle ranching has as many manifestations as there are ranchers, and each of the ranchers, identify the world through the lenses of their own experiences. Each can see the same region with a different perspective. A constructivist viewpoint, then, would argue that knowledge – that is, not just physical facts themselves, but our relationship to facts, what they mean to us, and how relevant they are – is constructed by our social context (Groat and Wang, 2001). It is a way of analyzing meanings and power relations in a place (James, 1904). The *critical* part of this equation is the decision to alter those meanings and power relationships in an emancipatory frame (Marx, 1908).

In sum, how we interpret reality will influence our actions. Therefore, these perceptions of truth and interpretations of facts are crucial aspects of how reality is created. So, to understand cattle ranching in Vermilion Parish, I tried to examine the interaction of the viewpoints of 15 interview and 3CM respondents, resilience theory, the archives, and maps.

Chapter 3: Resilience Theory

Resilience is a word that is used extensively – particularly in conjunction with the Louisiana Gulf Coast. In fact, many would say that it is over used, or used to the point of becoming meaningless. This is exemplified in a conversation I had with a friend of mine: he was assuming that my advisor had determined my research topic, so when I explained what my research was about, and used the word *resilience*, he confided "aren't you so tired of people talking about resilience this, resilience that? It doesn't even mean anything anymore!" Little did he know that not only did I chose and pursue this topic with excitement, but that there is an extensive body of literature associated with resilience theory and how to conceptualize it and measure it. And so, with the intention of understanding the adaptive capacity of cattle ranching in Vermilion Parish, I will draw from Resilience Ecology and the theory of Social Technological Ecological System (STES), as well as field interviews, archival research, and spatial analysis. This chapter will position my field data in relation to the theoretical problem of resilience and adaptive capacity. This research will build on and extend the existing research by applying the concepts of complex human ecological systems and resilience theory from the literature to Vermilion Parish, Louisiana.

RESILIENCE ECOLOGY

Resilience ecology has evolved since C.S. Holling first applied the concept of resilience and alternate stable states in his paper "Resilience and Stability of Ecological Systems" (Holling 1973). In this 1973 article, resilience was stated to be one of the defining characteristics of an ecological system. According to Holling, resilience is an inherent property of a system – it determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes and still persist.

More recently, the definition of resilience has evolved to indicate the capacity of a social ecological system to *absorb disturbance* and *reorganize while undergoing change* so as to retain essentially the same function, structure, identity, and feedbacks (resalliance.org, 2001). This definition is widely used by scholars such as Brian Walker and Carl Folke, members of the Resilience Alliance.

In 1999, C. S. Holling founded the Resilience Alliance, an independent research organization of which Brian Walker, one of the key scholars identified above, is chair. It is comprised of researchers, university affiliates and practitioners and the purpose is "collaboration in the exploration of the dynamics of social-ecological systems" (resalliance.org, 2001). This group of scholars and practitioners collaborates in the development of knowledge and collectively contribute to research surrounding the fundamental concepts of resilience, adaptability and transformability.

In order to get the most out of this brief introduction to resilience, I will begin by clarifying and defining several key concepts. I will start at the beginning, with the statement that "resilience is an inherent property of a system."

SYSTEMS AND BOUNDARIES

What is a system, and how do you define, or delineate, a system of analysis? For the purposes of this research, I will define a system as a regularly interacting or interdependent group of items forming a unified whole. In this case, a system may be a political unit, such as Vermilion Parish; a watershed area, such as the Teche-Vermilion watershed; a social-economic system, such as cattle ranchers, stockyards and related people and industries; or a technological system, such as the canals, levees, dams and dykes that control the hydrology of the area. These spatial and temporal boundaries define the focal system. How this system is delineated, or what is considered to be part

of a system, can significantly impact the research question. For the purposes of this research, I will consider the system to be the activity of cattle ranching operating within Vermilion Parish as a spatially and politically discrete unit.

SOCIAL-TECHNO-ECOLOGICAL SYSTEM

Along these same lines, social-techno-ecological systems, or STES, are complex, integrated systems in which the boundaries between humans, technology and nature are blurred. This definition indicates a false distinction between purely social, technological or ecological systems (Berkes and Folke, 2000). The Cheniers of southwestern Louisiana are a strong example of a social-techno-ecological systems because the Cheniers were formed during human occupation of the area. Given that early societies have interacted with these landforms even as they were forming, the people, the landforms, and the technologies (i.e. canals, levees, and other constructions) have co-evolved in a specific way as a result of this interaction. *Chapter 4: History and Background* will look deeper into the geomorphological, technological, and cultural history of the Cheniers

Another concept embedded in the definition of resilience is the idea that at some point these systems may change: "…ability of these systems to absorb changes and still persist" and "…a qualitatively different state that is controlled by a different set of processes." The questions arise: what happens if a system is *not* resilient, does not persist, and does become controlled by a different set of processes? At what point will this happen and what would cause a system reach this unsustainable or unregenerative point?

REGIME SHIFT

The Louisiana Chenier Plains have a distinctive hydrologic regime. The marshes of SW Louisiana are quite flat and typically have very few canals or bayous, no natural

levees, and water moves primarily as sheet flow over the surface. This configuration is unique in the region – it is quite unlike the bayous of the deltaic plain and the drainage of the uplands. The Resilience Alliance defines a regime as "an identifiable configuration of a system. It may also be called a system state. A regime has characteristic structures, functions, and feedbacks, and therefore a unique identity" (Assessing Resilience, 2010). The system state in the marshes, therefore, would be defined by the rainfall, the vegetation, the salinity zones, and its tidal interaction with the Gulf of Mexico.

With the development of dredging, spoil banks, and levees along the Mississippi River, the Louisiana Chenier Plain, it may be argued, underwent a hydrologic regime *shift*. For many years, hydrologic activity such as soil saturation, sheet flow, and salinity was controlled primarily through rainfall, soil type and tidal action. Once access canals through the marsh were dredged, levees along these canals and along the Mississippi River were built, and dams along the Mississippi and Atchafalaya Rivers were constructed, people and technology became the primary agents of hydrologic activity (Interview, Feb. 2013). A regime shift, therefore, is a rapid or sudden shift of an ecosystem from one relatively stable state (or regime) to another. After a regime shift, the system is controlled by a different set of processes – in other words, a threshold is crossed and the core functions, structure, and processes of the new regime are fundamentally different from the previous regime (Scheffer and Carpenter, 2003; Assessing Resilience, 2010).

This idea of a state, or regime, has been illustrated using a ball and cup diagram, as in Figure 4 below. The valley where the ball, or system, is at rest, represents stability domains, or regimes (resalliance.org, 2001). The arrows represent disturbances, or circumstances that would push the system over a threshold, into a new regime.

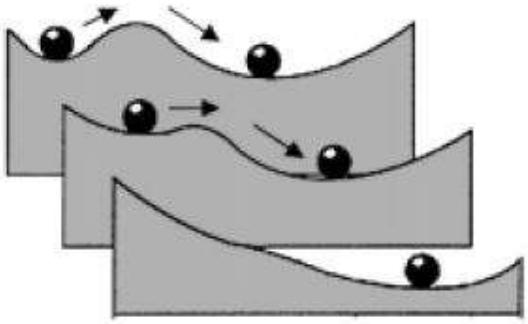


Figure 4: Regime Shift

> In this illustration of a regime shift, the ball is the system and the valley is the regime. The first diagram illustrates the hydrologic regime of marshes maintained using levees. When disturbances such as hurricanes occur, the system would be pushed over the threshold into a new regime of open water. Source: Gunderson, L. H., & Pritchard, L. (2002). *Resilience and the Behavior of Large-Scale Systems*. Island Press.

There are three types of resilience represented in this example. The first type of resilience, called engineering resilience, would be the capacity of the system to withstand a disturbance. In other words, how strong of a hurricane would be required to push the levied system into a new regime of open water? This idea is represented in the heuristic above by the angle of the slope of the valley. In this example, the engineering resilience of the system is further destabilized, i.e. – the height of the peak is reduced – by the failure of land managers and land owners to maintain their levee systems. The second type of resilience is the ecological resilience, or the buffer capacity. This would be how well the system can withstand shock and maintain its core functions. This ecological resilience, also called social resilience in the table below, would be described by the width of the valley, illustrated above, or its buffer capacity. Adaptive capacity, as I will discuss more later on, would be the ability for the ball, or system, to stay relatively stable,

even as the diagrammatic landscape of slopes and valleys change around it. The third type of resilience, called social-ecological resilience, is the landscape of the heuristic as a whole and how the system interacts with these peaks, valleys, and disturbances. These three types of resilience are outlined below in Table 2: Characteristics, Focus and Context of Resilience Concepts.

Resilience concepts	Characteristics	Focus on	Context
Engineering resilience	Return time, efficiency	Recovery, constancy	Vicinity of a stable equilibrium
Ecological/ecosystem resilience social resilience	Buffer capacity, withstand shock, maintain function	Persistence, robustness	Multiple equilibria, stability landscapes
Social-ecological resilience	Interplay disturbance and reorganization, sustaining and developing	Adaptive capacity, transformability, learning, innovation	Integrated system feedback, cross-scale dynamic interactions

Table 2: Characteristics, Focus and Context of Resilience Concepts.

Source: Bedeau , C., & Ng, E.-L. (2009). Ecosystem resilience. *Open Landscapes: Knowledge Collection for Landscape Science*. Retrieved from http://openlandscapes.zalf.de/openlandscapeswiki_glossaries/Ecosystem%20resilience.aspx

DISTURBANCE

What would cause this type of regime shift? The Resilience Alliance ties regime shifts both to a state of reduced resilience (as when levees are not maintained properly and the height of the peak is reduced) and to disturbances (resalliance.org, 2001). A disturbance can generally be thought of as a discrete event in time coming from outside

the system that causes a disruption to the focus system. It may create opportunities for new components of a system to become established (Smith, 1990; Assessing Resilience, 2010). One common disturbance in Vermilion Parish is the occurrence of a hurricane. The Resilience Alliance points out that one result of decreased resilience is increased vulnerability to disturbances that previously the system could absorb and cope with (resalliance.org, 2001). In this example, although the magnitude and frequency of hurricanes affecting Vermilion Parish has generally increased over time, even the smaller storms are having a larger impact than they have in the recent past.

The Resilience Alliance, in their workbook for practitioners, identifies two different types of disturbances: a *pulse*, or a relatively discrete event in time such as a hurricane, and a *press*, or a more gradual or cumulative pressure on a system such as the practice of dredging canals through the marshland. A reduction in system resilience increases its vulnerability to smaller scale disturbances. Therefore understanding the pattern and types of disturbance can inform management practices (Assessing Resilience, 2010).

THRESHOLDS

Within the idea of a regime shift is the suggestion of a threshold, or tipping point. As illustrated in Figure 4 below, a threshold is simply the breakpoint between two regimes, or the line between the old system and the new system (Walker and Meyers, 2004). At some point, for instance, the canal-riddled marsh that was previously managed effectively with levees, crosses a threshold and those same management techniques are no longer effective. Both pulse and press disturbances have the capacity to cause a system to cross a threshold into a new regime. This is especially true if resilience has been decreased over time.

To take this idea a step further, it may be harder to transition from state A to state B than to transition back from B to A (resalliance.org, 2001). This is, again, demonstrated in Figure 5 by the steepness and height of the slope between Regime 1 and Regime 2. For instance, a shift from brackish or intermediate marsh to open water in Vermilion Parish may be significantly easier than moving from open water to marsh. Marsh can transition to open water in the time frame of only a few years with the construction of a few canals or levees. However, to shift from open water back to marsh would require significantly more than just taking down levees or filling up those canals. It may require political action, a change in how people interact with the marsh land, cost effective (de)construction plan as well as a nuanced understanding of the ecology of the area.

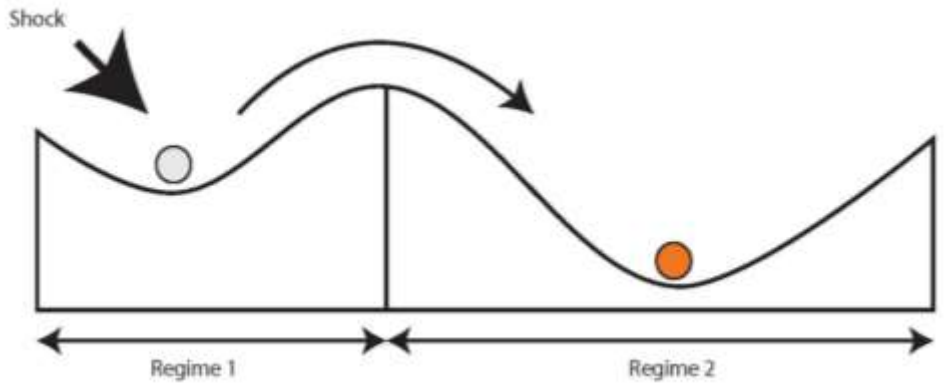


Figure 5: Thresholds

> A system can be pushed over the threshold between two regimes by a pulse or press disturbance. Once it has undergone a regime shift and is operating under a different set of controls, it may be quite difficult, or even impossible, for the system to transition back to its previous state. Source: Insight #2: Regime Shifts. (2012, May 7). *Stockholm Resilience*. Retrieved from http://www.stockholmresilience.org/21/news/research-insights/regime-shifts.html

In order to intentionally increase resilience, a resource manager must know the nature of the system thresholds and how to either prevent the system from crossing a threshold or how to deliberately transition it from the undesirable to the desirable regime (Assessing Resilience, 2010). The challenge, of course, is that these thresholds are not static and are decidedly difficult to identify. Because of this, and because these thresholds are affected by other, unidentified influences, a knowledge of the factors that would push the system *beyond*, rather than just *to*, a threshold is needed for effective management (Assessing Resilience, 2010).

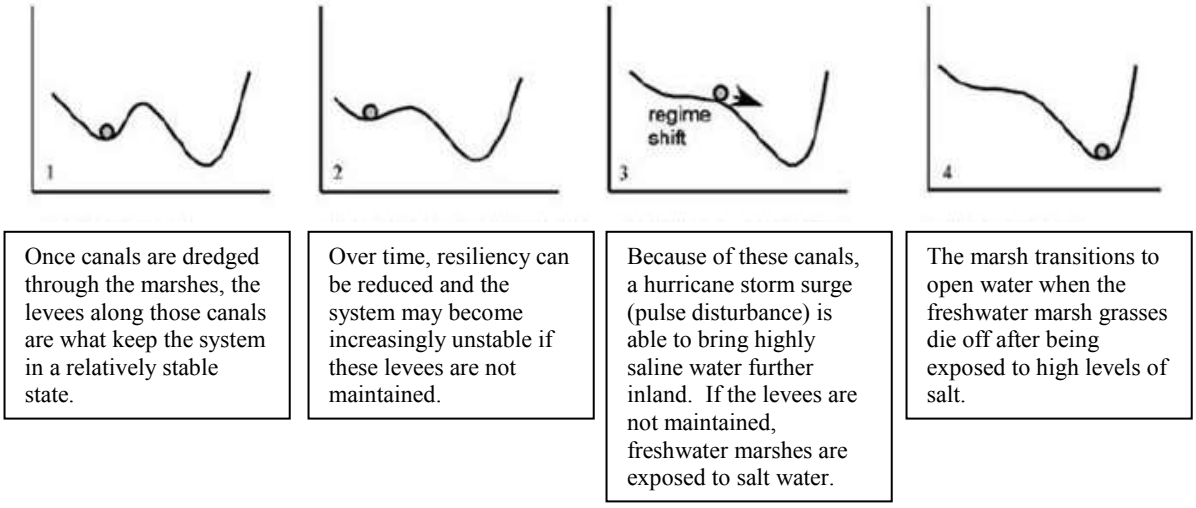


Figure 6: Regime Shifts

As the conditions change, the system is made more or less vulnerable to disturbance, thresholds change. At some point a disturbance causes a regime shift to occur. This, in turn, results in a transition to an alternate state. As depicted in the diagram, the transition from Alternate State 1 to Alternate State 2 may be easier than the transition from State 2 to State 1. Source: Diagram: Bedeau , C., & Ng, E.-L. (2009). Ecosystem resilience. *Open Landscapes: Knowledge Collection for Landscape Science*. Retrieved from http://openlandscapes.zalf.de/openlandscapeswiki_glossaries/Ecosystem%20resilience.aspx. Text: Danica Adams.

Even within a particular regime, most systems are dynamic and change over time, often without crossing a threshold or undergoing a regime shift. As long as the controls and feedback loops are the same, this system would be considered to still exist within the same regime. It is only once the internal controls and feedbacks have changed that a new regime, separated by a threshold, has been entered (Walker et al. 2006).

ADAPTIVE CYCLE

System changes often follow a similar pattern of growth, conservation, release, and reorganization. This is the adaptive cycle. The adaptive cycle is a conceptualization of change used to describe four commonly occurring phases of change in complex systems (resalliance.org, 2001). Four distinct phases of change have been identified and are illustrated in Figure 7:

1. growth or exploitation (r)
2. conservation (K)
3. collapse or release/ creative destruction (omega)
4. reorganization or renewal (alpha)

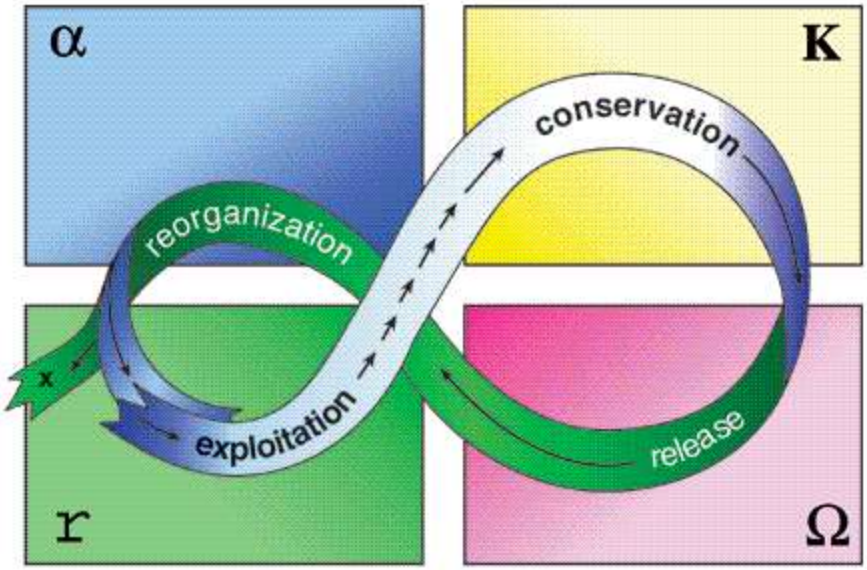


Figure 7: The Adaptive Cycle

The adaptive cycle includes four phases: growth, conservation, destruction, and reorganization. Source: Gunderson, L. H. (2001). *Panarchy: Understanding Transformations in Human and Natural Systems*. Island Press.

The adaptive cycle contains two major phases. The first, or the fore loop, from r to K, is the period of rapid growth followed by increasing interconnectedness and inflexibility, which slows this growth. In the early days of cattle ranching in Vermilion Parish by European settlers, the prairie was a vast, unbroken landscape of high quality forage and no restrictions – these ranchers were in the r phase. As ranchers increased their holdings, they became gradually more dependent on the customer base of cities and towns in order to sell their beef and pay for their land and cattle. This dependence, or interconnectedness, decreased their flexibility to adjust their herd size, adapt to losses or weather economic downturns – all characteristics of the K phase.

This period of growth and interconnection is followed by the back loop, or the transition from Omega to Alpha. This period is characterized by a disturbance and

subsequent rapid phase of release and reorganization (resalliance.org, 2001). The Omega stage is when highly interconnected resources become increasingly fragile. It is marked by vulnerability to disturbances, which may then cause the collapse or destruction of the systems created during the first two phases. In the late 1800's and early 1900's, for example, the railroad connecting Houston to New Orleans was laid through this prairie that the ranchers used for grazing. Because of the proximity and access to markets, as well as the soil type, the northern part of Vermilion Parish was quickly transformed from vast open prairie to a rice-growing region (Bradshaw, 1991).

This disturbance in the Omega stage is then followed by the Alpha phase of reorganization and reconfiguration. Over time, cattle farmers began to see the value in rotating cows through their rice fields. In this way, the cows cleaned up the rice stubble and fertilized the fields, preparing it for next season's planting (Jones, 2007). It is during this reorganization of structure that novelty and mutations of the system have the opportunity to take hold and a regime shift is most likely to occur. This relationship between rice and cattle remains a common way to use the land. It is worth noting that this is a general characterization of the order and timing of phases in the adaptive cycle – while there are deviations from this, this remains the basic structure (Walker et al. 2006).

So far we have identified the cycle of increasing ranch size (r), followed by increasing dependence on large pieces of property and accessible markets (K). This is followed by the disturbance of the railroad (Omega) and subsequent adjustment of cattle ranching to incorporate rice into their rotation (Alpha). As resiliency decreases and/or disturbances increase in severity and frequency, this cycle moves faster. If, on the tail of the development of the railroad, there was a strong hurricane, follow by a reduced demand for beef, the system of cattle ranching in Vermilion Parish would have had less (or no) time allowed for reconfiguration and reorganization and regrowth. Had this been

the case, cattle ranching would look and function significantly differently than it does today, and possibly cease to exist. In this way, we can conceptualize vulnerability as a condition of the system that is created over time and begin to see how a social-techno-ecological regime shift may precipitate.

PANARCHY

Adaptive cycles are not determinant cycles; instead, they are nested in a hierarchy across time and space. A nested hierarchy of adaptive cycles is called a Panarchy (Walker et al. 2006). This concept is illustrated in Figure 8 by a series of nested adaptive cycles.

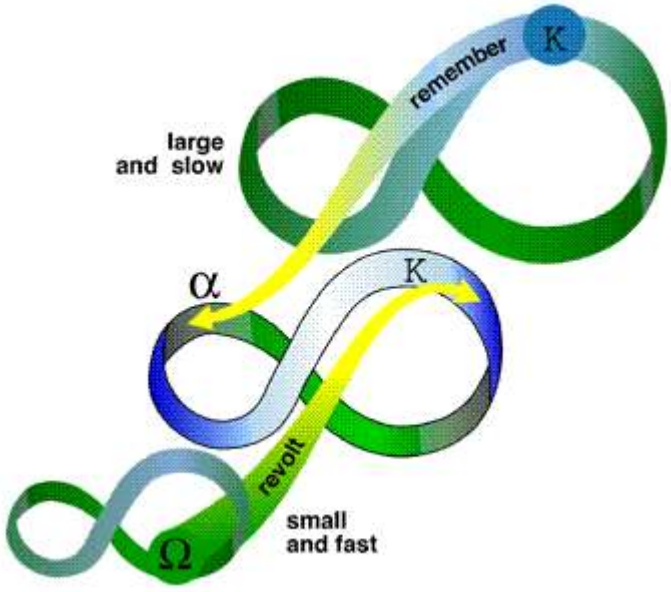


Figure 8: Panarchy

The cross scalar interaction of different systems is depicted by a series of nested adaptive cycles that influence each other across space and time. Source: Gunderson, L. H. (2001). Panarchy: Understanding Transformations in Human and Natural Systems. Island Press.

Panarchy, one of the most comprehensive frameworks for assessing multiple systems, describes social-techno-ecological systems as having functions and structures

that cover spatial and temporal scales and are nested within other systems. Panarchy describes hierarchical systems with multiple interrelated elements. These elements interact and affect each other across multiple scales; therefore, the dynamics of the system of interest "cannot be understood without taking into account the dynamics and cross-scale influences of the processes from the scales above and below it" (Walker et al. 2006). The previous example, used to describe the adaptive cycle, is nested within a larger and slower cycle of increasing levels of development across the Gulf Coast over time (the railroad system was connecting these places where development was taking place). This is, in turn, nested within the even larger and even slower cycle of nutrient and sediment transport from the Mississippi and Atchafalaya River deltas. The levees and hydromodification projects in other areas of the Gulf Coast change the sediment transfer and deposition patterns, and new cheniers are not being made (Penland and Suter, 1969).

Different processes operate and interact at different times and scales (cross scalar interaction). Walker et al propose that "slowly changing variables control ecological resilience, whereas social resilience is controlled by either fast or slow variables (Walker et al. 2006). Landscape-scale management, needs and processes, are composed of individuals making individual choices that create a collective or common landscape.

Some factors that affect the central adaptive capacity of cattle ranching in Vermilion Parish include:

- Market demand – fluctuates over months and years
- Parasite levels – fluctuate over seasons
- Hurricanes – two time scales: weeks and years

- Vegetation quality and quantity – seasonal time scale: quantity and quality are highest during spring and lowest in summer; burning during the winter months stimulates new growth
- Draining marshes with levees and dykes – measured over generations
- Salt is laid down over the landscape during hurricanes, which occur every couple of years
- Generations who want to ranch
- Insurance rates – slow cycle that fluctuates over decades
- Weather –seasonal temperature and precipitation patterns fluctuate over years or decades

In the panarchy model, the aggregation of small and fast scale cycles (such as parasite loading) generate the conditions for a release (*k*-phase) disturbance at the scale of a herd. Chenier creation processes and saltwater infiltration, which both operate at larger scales than the parasites or the herd, influence recovery of the herd after the parasite disturbance. At larger temporal scales, people from younger generations learn ways of interacting with the landscape based on traditions handed down from generation to generation. These traditions are used to reorganize the system after the *k* phase. Since the traditions are developed prior to the disturbance, they are considered part of the system's memory. Infusions of capital in the form of traditions and a high quality and quantity of vegetation in the marshes are crucial for recovery. In the social domain, insurance (a form of memory), market demand, technology (such as fencing) and social networks can also be critical to recovery from natural disasters (resalliance.org, 2001).

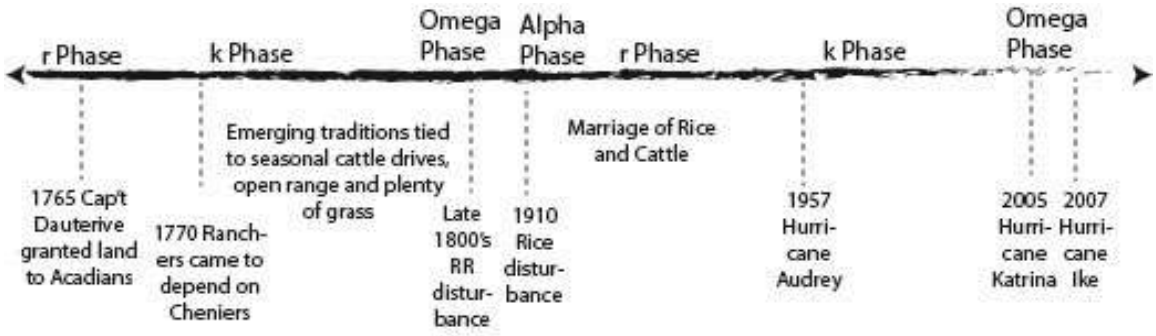


Figure 9: Resilience Timeline.

This timeline of events includes the corresponding phases of the adaptive cycle they indicate. Source: Danica Adams

ADAPTIVE CAPACITY

Adaptive capacity is, simply, the capacity to adapt to and shape change (Berkes and Folke, 2000). A system with high adaptive capacity will be able to reflexively respond to changes or disturbances without getting stuck in the Omega, or de-construction, phase of the adaptive cycle. It will also be able influence and manage the disturbance and reorganization of elements (resalliance.org, 2001). Adaptability is the capacity of actors in a system "to manage resilience, either by moving the system toward or away from a threshold that would fundamentally alter the properties of the system, or by altering the underlying features of the stability landscape (change the positions of thresholds, and the ease of movement of the system" (Walker et al., 2004). This ability is influenced by social, technological and ecological aspects of the system (resalliance.org, 2001). For instance, the system of cattle ranching in Vermilion Parish includes a social aspect that helps move the system through the Omega and into the Alpha phases by managing the negative effects of storms. Before a hurricane, the ranchers and cowboys in an area will get together with their trailers and horses to help round up and transport cows out of harm's way. After the storm, when the ground is still salty, they have a

practice of renting pastures in higher ground while levies are rebuilt, fences repaired, and pastures pumped off. If the effects of the storm were more severe than expected, the community will help organize assistance for those families. In this case the reorganized system has, thus far, looked and functioned similarly, although not exactly, to pre-disturbance conditions.

Conversely, lack of adaptive capacity negatively affects the transition from the *omega* phase (reorganization) to the *alpha* phase (growth). Thus, it affects the capacity of the system, or the actors in the system, to restructure itself in response to new circumstances and build new, useful connections. After hurricane Rita in 2005, many of the large remaining ranchers in the southern part of the parish decided to sell out. This is because they lost too much and couldn't afford to rebuild, they were aging and had no one to help out or take over, and they were losing pasture the marshes to open water (Interview, Feb. 2013). In this instance there were limited options for restructuring, and the system had difficulty doing so – the result of low adaptive capacity. As we can see, one result of low adaptive capacity is constrained options after a disturbance. The effect of this is for the social-ecological system to emerge from such a period along an undesirable trajectory (Fikret, Johan, and Folke, 2003).

Systems with high adaptive capacity share a common set of characteristics. They are able to, following a pulse or press disturbance, reconfigure themselves without losing their primary functions. For example, if the system of cattle ranching in Vermilion Parish has high adaptive capacity, when it experiences a hurricane or flood, the actors are able to continue to ranch. While they may make allowances for downed fences or for temporarily flooded pastures, their primary function – raising cattle for beef production – is not lost.

While both ecological and social systems with high adaptive capacity share this general ability to roll with the punches, they each have a unique set of traits that allow them to do this. Ecological systems that have genetic and biological diversity and are composed of diverse or dissimilar landscape mosaics may be considered to be higher in adaptive capacity (resalliance.org, 2001). In a pasture composed of multiple species of grasses, each will react differently to the minute disturbance of grazing or the larger disturbance of salt water inundation. Social systems may have a stronger ability to adapt to change or shape change in their favor when they have institutions and networks that have institutional memory and which learn from it, when they can create flexibility in problem solving and are able to balance power among interest groups (resalliance.org, 2001). In the social system of cattle ranchers and their friends, the traditions and local ecological knowledge that is passed down through generations or shared among actors contributes to the perpetuation of the system.

RESILIENCE IS KEY TO ENHANCING ADAPTIVE CAPACITY

The Resilience Alliance uses the following definition of resilience: "Ecosystem resilience is the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes. A resilient ecosystem can withstand shocks and rebuild itself when necessary" (resalliance.org, 2001). Adaptive capacity is the ability of the system or the actors in that system to help manage its resilience. There are four identified ways to intentionally increase adaptive capacity of a system; they interact over time and across space (Fikret, Johan, and Folke, 2003):

- learning to live with change and uncertainty;
- nurturing diversity for resilience;

- combining different types of knowledge for learning; and
- creating opportunity for self-organization towards social-ecological sustainability.

Cattle ranching is a combined social, technological, and ecological system (STES), so, as described, one component that affects its adaptive capacity is institutional memory. As illustrated in the examples above, the success of hurricane recovery lies in part with help from neighbors. This help is not possible without institutional memory of how things are done and what has worked or not worked in the past. The next story of why some of these larger ranches sold out after hurricane Rita is, in part, because there are not enough people with that institutional memory and knowledge. A large rancher in the southern part of the parish would rely heavily on knowledgeable cowboys and large tracts of high ground in the marshes to be successful. Without enough of those things, he would be forced to sell out. In this way, he has a lower adaptive capacity.

Since current conditions are formed by the historic and present interaction of social, political, environmental, technological and economic forces, conditions are constantly changing. In order for a system to continue to be functional or to remain relevant, it must maintain high levels of adaptive capacity. In Vermilion Parish, not only are baseline conditions constantly changing, but the frequency of disruptions in the form of hurricanes, floods and saltwater intrusion are also increasing. Gunderson and Holling state that resilience is the key to enhancing the adaptive capacity of a system (Gunderson, 2001). They go on to say that addressing how individuals respond to periods of change or disruption and how society reorganizes following change, is "the most neglected and the least understood aspect in conventional resource management and science" (Gunderson, 2001). In this sense, I hope to extend our current understanding of STES adaptations to disruptions, specifically the capacity for adaptation of the cattle ranching system in Vermilion Parish. In Chapter 6: *Synthesis* I will present a series of

recommendations and suggestions that are geared towards increasing the adaptive capacity of the cattle ranching system in Vermilion Parish.

In the next chapter, *History and Background*, I will present three different versions of the history of cattle ranching in Vermilion Parish. Throughout the accounts, I will connect the history to the theory presented here.

Chapter 4: History and Background: Three Different Angles

Telling "the story of how things got to be the way they are" is difficult. Not only are there limitations to what we know to be true, there are also practical considerations of how to weave multiple angles into a single narrative, or story of origin. Which descriptions we choose to provide will inform our approach to any given situation, and will suggest certain methods of analysis: "In order to understand the resilience of a system, you must describe its current state as well as its historic and potential future states" (resalliance.org, 2001). In making the decision about what information to include and which topics to draw from in describing these historic, current, and future states, I turned to resilience theory and the "Rule of Hand." This rule of hand suggests finding three to five components that affect the focal system. By reducing the number of moving parts in the equation, this approach highlights the interactions of the key elements and how they respond to external forces. This rule of hand also allows for streamlining the inherent complexity of the system and creating a rough sketch of the nature of their relationships without being overly reductive.

Since I have been referring to the system of cattle ranching in Vermilion Parish as a social-techno-ecological system (STES), in this chapter I provide the history and background of the system from each of these three perspectives. I begin by discussing the geomorphological history of Vermilion Parish (ecological), followed by the history of cattle ranching in Vermilion Parish (social). I then review the background of hydrologic change in Vermilion Parish and some of the political decisions associated with that (technological). Although in this chapter I present these as disparate perspectives, each of them overlaps and interlocks with the other, providing one view of the larger picture. I

then use this to inform the data analysis in Chapter 5 and my recommendations in Chapter 6.

ECOLOGICAL HISTORY: GEOMORPHOLOGY OF SOUTHWESTERN LOUISIANA

I begin by allowing that the Gulf Coast is an active and changing place, undulating in time and shifting in our imaginations. The region means many things to many species, and has held countless other meanings in its sweep through time. As shown in Figure 10, within Louisiana's boundaries, the coastal area can be roughly divided by the Vermilion Bay and the Atchafalaya Basin: the Deltaic Coastal Marshes to the east and the Chenier Plain lies to the west.

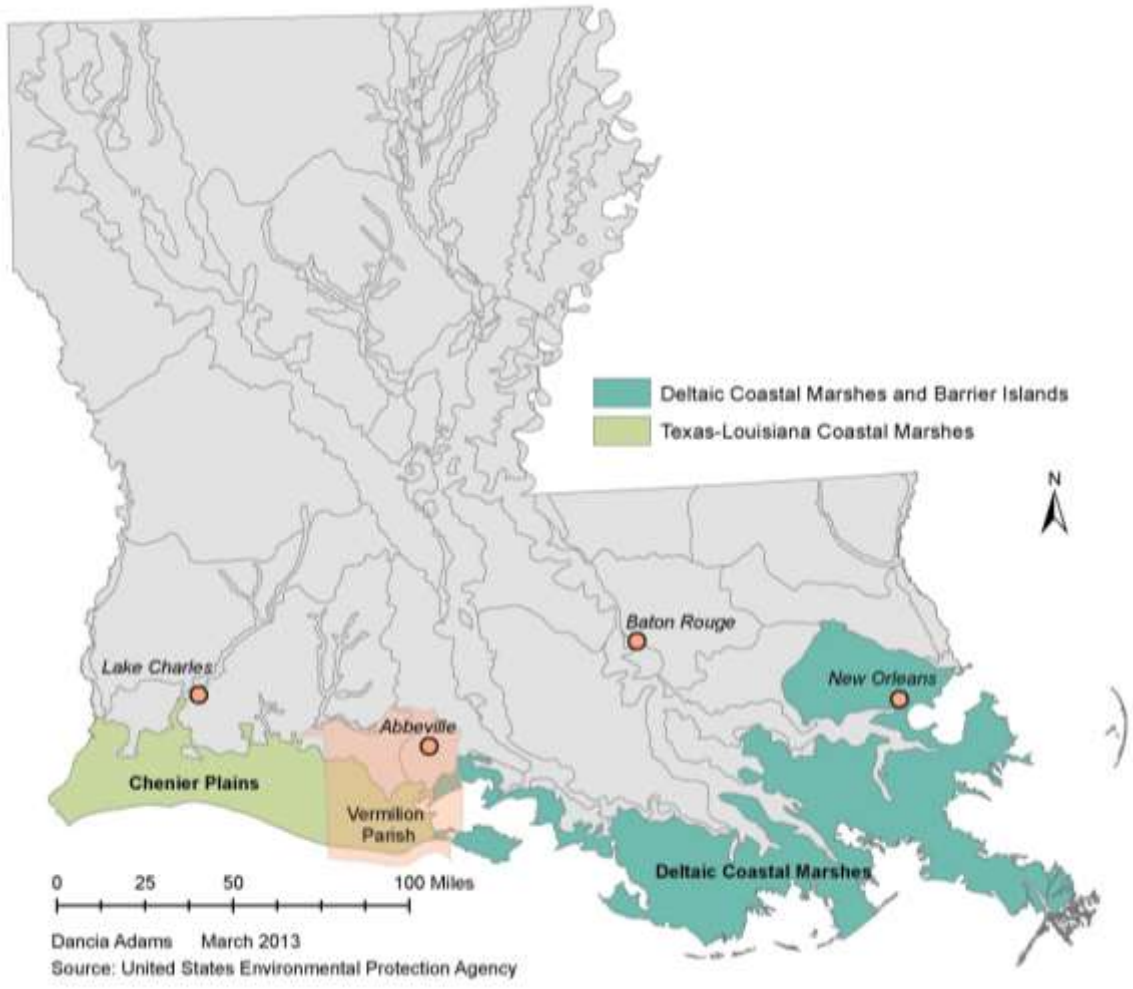


Figure 10: Geomorphological Context Map

Source: GIS data set: US EPA. (2012). Level IV Ecoregions of Louisiana. U.S. EPA Office of Research and Development (ORD) - National Health and Environmental Effects Research Laboratory (NHEERL). Map by Danica Adams

The Deltaic Marshes, formed by repeated deposits of silt from the overflowing banks of the Mississippi River, is that area south of Baton Rouge and New Orleans. The Deltaic Coastal Marshes are marked with bayous, rivers, and levees, natural or otherwise (Penland et al. 1990).

The Chenier Plain, approximately 2,402 mi^2 of marsh, open water, and Chenier habitats, is more of a slow, largely treeless, miles-wide transition from land to water (Gammill, 2002). Marshes within Louisiana's Chenier Plain began forming about 3,000-4,000 years ago during periods when the Mississippi River followed a westerly course (Gammill, 2002). The open saline water of the Gulf transitions to Cheniers, or oak tree covered ridges. As you move north from the Cheniers, the salty water of the Gulf is gradually diluted as freshwater becomes more and more plentiful. The brackish emergent wetlands north of the Cheniers eventually give way to intermediate and then freshwater zones of marsh which support a different mix of vegetation altogether (Gammill, 2002). According to the Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority (LCWCRTF/WRCA 1998), within the Louisiana Chenier Plain, 554 mi^2 (47 %) is fresh marsh; 264 mi^2 (22%) is intermediate marsh; 310 mi^2 (26%) is brackish marsh; and 52 mi^2 (4%) is saline marsh (Gammill, 2002).

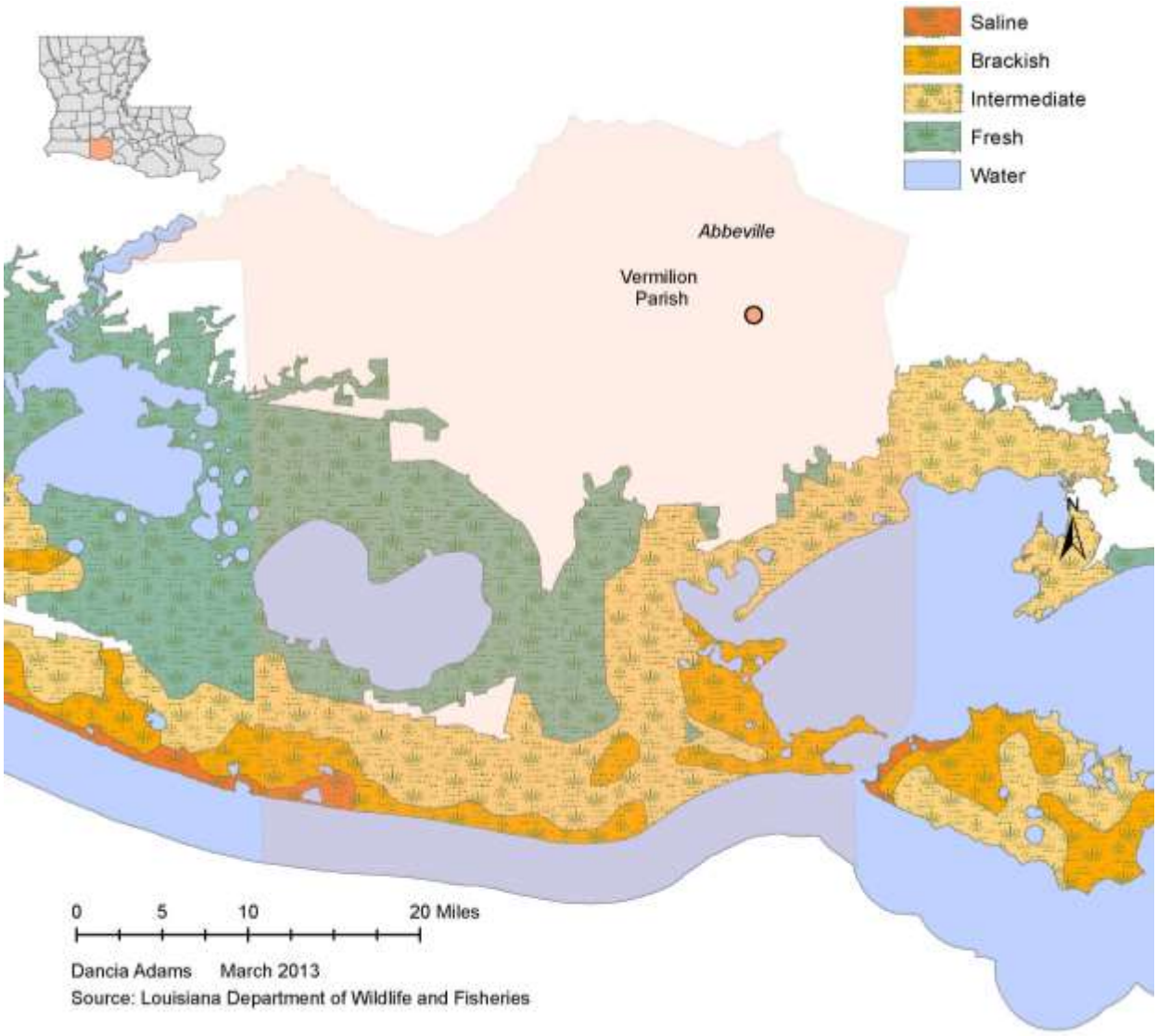


Figure 11: Salinity Zones of Southwestern Louisiana.

Source: Louisiana Department of Wildlife and Fisheries. (2001). esi_salinity_LDWF_2001. ESRI. Map by Danica Adams.

The Cheniers themselves (not the Chenier Plains) are a series of ridges that run parallel to the Louisiana shoreline for 125 miles from Southwest Point, Louisiana to Sabine Pass, Texas, that are between 12 to 20 miles wide, and have elevations of 6 to 20 ft above mean sea level (Penland and Suter, 1969). This slight elevation above the

surrounding marsh allows oak and hackberry trees to thrive in this otherwise treeless area (Neyland and Meyer, 1997). Appropriately, the term *Chenier* is derived from the cajun term *chene* for oak, the tree species that dominates the crests of the higher ridges (Penland and Suter, 1969). The Cheniers of Southwestern Louisiana are the largest of only a handful of Chenier ecosystems in the world (Gomez, 1998).

Figure 12: Vicinity Map of Cheniers in Southwestern Louisiana.

> This map was obtained from LDNR and shows the extent and general form of the long narrow ridges that we call Cheniers. Source: Providence Engineering. (2009). Cheniers and Natural Ridges Study (No. Project Number 227009). Baton Rouge, LA: Louisiana Department of Natural Resources.

Unlike the deltas, which are formed by river depositions of sediment coming down from land and accumulating at the mouth of the river, Cheniers are formed by sediment coming up, out of the Gulf, usually during hurricane events. They are the result

of accumulated particles of clay and silt that were so light that they didn't settle in the Deltaic Plain, although they likely originated from the Atchafalaya or Mississippi River. Instead, they were carried west by the strong east-to-west currents where they then settled in ridges along the shores of southwest Louisiana.

These hurricanes, or pulse disturbances, that helped pile the shorelines high with sediment, have prompted not a regime shift to a new state, but a mild re-organization of elements – in this case particulates in the Gulf of Mexico - leading to the creation of the Cheniers. At 800-1,000 year intervals, this sediment would accumulate, followed by deposits of sand and shell (Penland et al. 1990). While it is shown that these pulse disturbances are ones that the system has adapted to, and indeed have come to depend on, this process that builds new cheniers was stopped by a press, or long term, disturbance. The flood and navigation control levees along the Mississippi and Atchafalaya Rivers have halted the sediment availability that created the Chenier formations (Penland et al. 1990).

These Cheniers play a prominent role in the ways and means of cattle ranching in Vermilion Parish. In a land that functions right around mean sea level, an elevation change of one to two feet is considered significant, and ranchers will sometimes refer to an area that is five feet above sea level as "high ground" (Interview, Feb. 2013). Because of this, the Cheniers are seen as islands in the marshes, refuges from soggy ground and tidal action. Places like Mulberry Island, Beef Ridge, Back Ridge, Pecan Island, Marsh Island, and Chenier au Tigre (some of which are shown in the map below) are commonly referenced as historically – as well as currently – important in the business of raising cattle. Figure 13, below, gives context and shows the location of the Cheniers in Vermilion Parish.

Figure 13: Cheniers of Vermilion Parish

Source: Providence Engineering. (2009). Cheniers and Natural Ridges Study (No. Project Number 227009). Baton Rouge, LA: Louisiana Department of Natural Resources.

The map above, created by Louisiana Department of Natural Resources, depicts the location of 18 named natural ridges or Cheniers in Vermilion Parish. These long, narrow ridges, parallel to the coastline, are islands in the marsh, a cattle refuge from the low lands to the north. It is these places that cows spend their winters, driven through the marshes to the northern high grounds only when mosquitoes cover their bodies and hurricane season begins.

Figure 14, below, shows the geomorphology and cultural uses of the Cheniers in a cross section. Some of these Cheniers, especially Pecan Island and Back Ridge, have roads, electricity, and water services to accommodate the small settlements that

established around the cattle ranching tradition. The Cheniers are approximately 10 feet above the surrounding marsh and the residents are connected to the middle and northern part of the parish by Hwy 82, a two lane, paved road. Many of the houses are built on stilts, off the ground by anywhere from 5 to 15 feet.

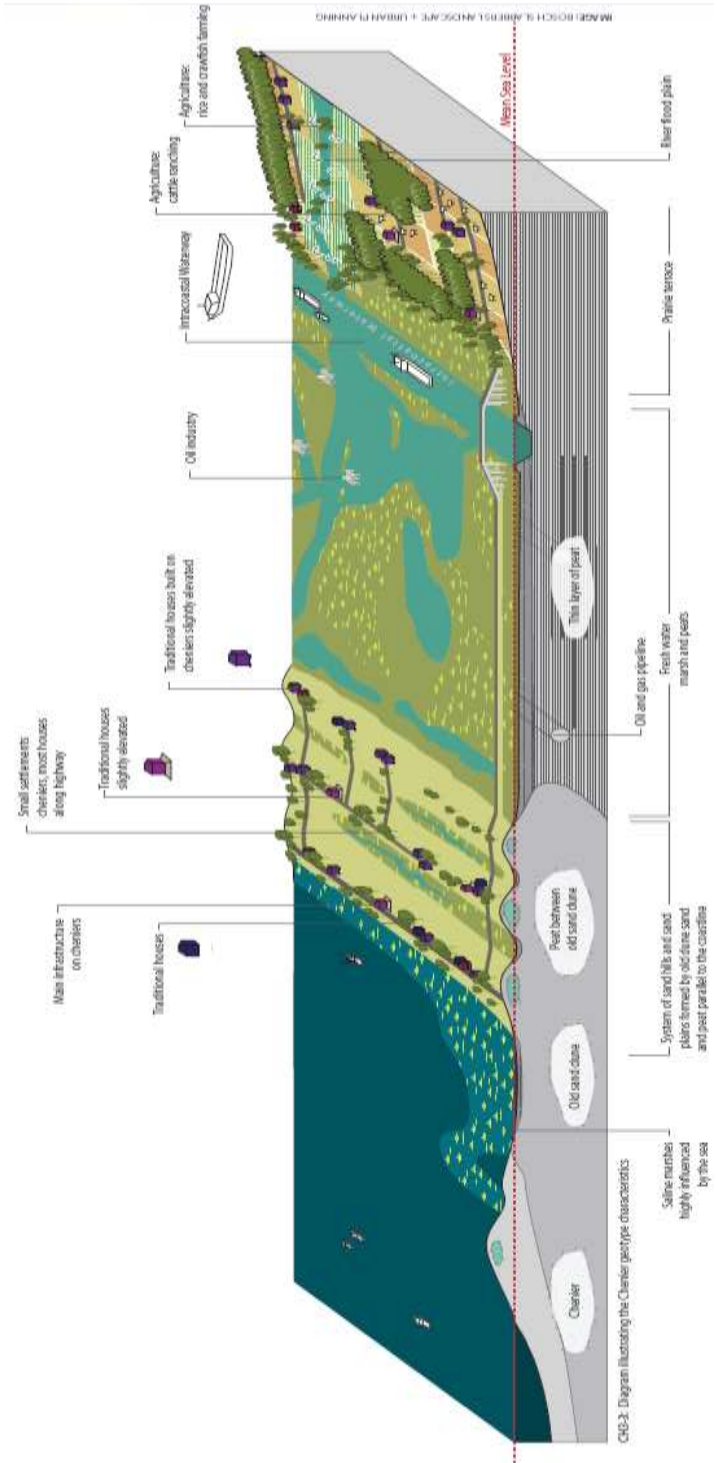


Figure 14: Cross Section of Chenier

Source: Center for Planning Excellence. (2012). Best Practices Manual For Development in Coastal Louisiana. Coastal Protection and Restoration Authority. Retrieved from http://coastal.cpex.org/

For the rest of the parish, these Cheniers are the first lines of defense against hurricanes. They are grasslands that developed with the regular occurrence of fire and grazing, saltwater and drought. The Cheniers have long been a refuge for people and wildlife, and those people and wildlife have influenced the form and function of the Cheniers.

In fact, Native Americans are estimated to have arrived in Louisiana about 12,000 years ago. Because the oldest Cheniers are less than 3,000 years old, it follows that

these ridges have experienced anthropogenic activity throughout their existence (Neyland and Meyer, 1997), and should be considered social-techno-ecological systems, or STES. While SES, or Social-Ecological Systems are defined as "complex, integrated systems in which humans are part of nature" and which change and evolve as one unit (Berkes and Folke, 2000), I will specifically alter this definition to include "technologies." I will define STES as complex systems in which humans, technology and nature are integrated and which change and evolve as one unit. In fact, in a wonderful example of an emergent STES, local oral history claims that as the Cheniers were forming, the Native American tribes, and later the marsh trappers and cattle ranchers, would routinely burn the marshes (Interview, Feb. 2013). While Native Americans and trappers would burn the marshes to allow for easier travel and to drive the muskrats and otters into their traps, ranchers currently burn to stimulate new plant growth and get rid of dead, high cellulose grass (Nyman and Chabreck, 1995). From an ecological standpoint, certain types of fire can enhance herbaceous root growth and discourage tree establishment (Neyland and Meyer, 1997). In this way, the physical characteristics of the Chenier Plains are common with other fire-dominated ecosystems (Nyman and Chabreck, 1995). Currently, however, cattle ranchers are the only ones who continue this tradition.

I suggest that without regular burning, the cheniers will be dominated by a new set of processes and if this happens, they will have crossed a threshold and experienced a regime shift. In this line of logic, an occupied landscape is a stable, or resilient, landscape.

SOCIAL HISTORY: HISTORY OF CATTLE RANCHING IN VERMILION PARISH

The following section of history has been pieced together from a wonderful book called Louisiana Cowboys, newspaper articles, and, especially, my interview respondents.

While the Native Americans in the area have helped shape the cheniers from their beginnings, this geography and natural resource availability shaped the settlement patterns and the political power dynamics of European settlers. In turn, it is these European explorers and settlers who have played the largest role in shaping the landscape of today. The Louisiana Chenier Plains, while diverse in grasses and forage suitable for ranching, did not have soils rich or deep enough to be considered desirable agricultural land. At the same time, the influx of exiled Acadians from Canada and Maine, many of whom were ranchers in the old country, led to the development of cattle ranching as the primary method of profiting off of these agriculturally marginal lands. This, coupled with the subsequent technological and socio-political changes, led to incremental landcover change in favor of ranching and an increasingly socio-techno-dominate ecosystem. In this section I will characterize the cultural history of cattle ranching according to the four phases of the adaptive cycle. As discussed in Chapter 3, the first two stages, *r* and *k*, which make up the fore loop, occur over a long period of time, while the back loop, or *Omega* and *Alpha* phases, frequently occur quite quickly. This storyline is intentionally structured to reflect the resilience theory perspective of ecological transformation.

There are conflicting stories about the arrival of cattle on the prairies of southwestern Louisiana. One story tells us that that multiple, large herds of livestock grazed the prairies long before the Acadians arrived and that the Avoyelles Indians had imported them in from Mexico (Bradshaw, 1991). Another version of the story states

that in an effort to establish a way for future settlers to live off the land, Cortez and other early explorers intentionally left pairs of cattle at every river crossing as they made their way through the southern region. These *corriente*, or common cattle, that were adapted to roaming wild, established themselves well on the rich prairies (Jones, 2007 and Post, 1957). As early as the 1730's, 30 years before the first Acadians arrived in the area, cattle brands were registered at the courthouse in St. Martinville (Bradshaw, 1991).

r Phase

In the second half of the 1700's, the cattle industry underwent a period of rapid growth and development that is characteristic of the *r* phase in the adaptive cycle. When the Acadians were expelled from Acadie during *Le Grand Dérangement* and exiled to the colonies, many eventually gathered in Louisiana. In an effort to gather these scattered French exiles in Louisiana, a nobleman by the name of Dautreive in New Orleans made an offer to help those escapees, some of whom were cattle ranchers in the marshes of old Acadie (Interview, Feb. 2013; Bradshaw, 1991). According to oral history and other sources, Captain Dauterive acquired 96,000 acres of land in 1765, while the area was under Spanish rule, and donated portions of it to those Acadian families who relocated to Louisiana. He then distributed to each family five cows, purchased from the Comanche Indians in Mexico, with the understanding that after six years, those families would repay Captain Dauterive and share the offspring and profits between themselves and the Captain. Three of the Acadian chiefs that negotiated this deal were Broussard families. The Broussard lineage, many of whom were cattlemen in old Acadie, remain prominent cattlemen in Vermilion Parish today and helped establish cattle ranching as a significant way to make a living (Interview, Feb. 2013; Post, 1957; Vermilion Historical Society, 1895).

In keeping with the French and Spanish systems of land allotment, government land was granted to families in long, narrow sections that fronted a waterway and extended into the prairies. The herds belonging to these different families ran together *au large* (Post, 1957).

k Phase

As ranchers enlarged their holdings, they became increasingly integrated with regional government and settlement patterns and dependent on large unbroken tracts of land, communal grazing rights, and the cultural traditions that supported their lifestyle. This growing dependence and interconnectedness associated with growth is a distinguishing component of the *k* phase of the adaptive cycle. For example, in 1770, the Governor of Louisiana Don Alexander O'Reilly issued a series of decrees regarding land and cattle. One of these decrees has played an important role in the development of cattle ranching in Vermilion Parish: "Cattle shall be permitted to go at large, from the eleventh of November [to] the fifteenth of March" (Jones, 2007; Post, 1957). This designation of communal grazing land in the marshes around the Cheniers during the winter months has resulted in a unique set of traditions surrounding cattle ranching and life on in the marshes. Since the marshes are so far south and are so close to the warm Gulf, the forage grasses rarely freeze. While cattle ranchers in other areas may have to make or buy hay – which requires either extra money or extra land – to feed their cows through the winter months, cattlemen in Vermilion Parish had access to seemingly endless supplies of grass, held in common. This required a seasonal migration from high lands in the north to marshes in the south, and back again. This then led to a very unique set of traditions and technologies that, in the spirit of STES, directly tied the people to the hydrology and

geomorphology of the Cheniers, and vice versa. This direct, iterative relationship could be used as a definition of a sustainable region.

One respondent said that years ago, people would tell stories of raising cattle approximately three or four miles northeast of the east end of Pecan Island in an area that was referred to as "the stomp." The stomp was close to 10,000 acres in size that was "excellent cattle range in the winter time because it was the remnant of an old beach ridge, but there was no ridge there. It was relatively high marsh." He went on to explain that "It was probably 6 inches or a foot maybe higher than some of the deeper marsh adjacent to it. And you got to understand in Vermilion Parish, one or two feet is a hill when you're living on such a flat topography" (Interview, Feb. 2013).

Emerging traditions in the k phase are types of institutional memory

Since the cattle roamed *au large* while in the marshes, all of the cattle had to be worked at the same time. Working the cattle in the spring meant that all of the cattlemen who had cows down south would mount their horses, with a spare mount in tow, and ride south together for the spring roundup. They would spend days on their horses, working together, riding through the marshes, finding everyone's cows and bringing them together, into a big "gathering." Once the cowboys, or *vachers*, were satisfied that they had found all of the stragglers, they began the long drive home, trailing anywhere from 1,000 to 5,000 head of cattle. Since there were new calves, unaccustomed to the 30 mile seasonal trek, the ride back up north to summer pastures would generally take two days or more, with a stopover along the way.

The marshes are pocked with lakes, bayous, bogs, and canals, so this journey was long and difficult, and required good horses with plenty of "cow sense." Navigating the landscape took a leader who knew the area "like his hand" – places where the cows might

get bogged down or where the hidden sinks were located. Instead of taking the long way around a canal, the ride home would take them right across a lake or across a canal. The front cowboys would lead the way, dismounting and then plunging their horses into the water, and the cows would follow right along. The rest of the cowboys would be there to keep the cows from pushing and crowding each other as well as to rope the youngest calves, tie them up and put them in a row boat to cross with the men.

Once the drive made it up north, then they began to work the cows. This involved using their horses to cut each rancher's cow/calf pair out of the herd and lead them to their parts. A good cowboy would know each brand and be able to work the herd slowly and steadily. This process could take days, depending on how big the drive was that year. Once the herd was parted, the work of throwing and branding new calves, and later worming, began. To do this, a cowboy would either rope the calf around the neck and wrangle it to the ground or throw it by hand to be worked.

This work was always done together, with the bigger operations bringing more cowhands to the drive than the smaller ones. That way each rancher put in their fair share of labor. These practices led to egalitarian work relationships between boss and cowhand, cooperative relationships between fellow ranchers, and a fine blend of independent and communal prosperity. Early brand records show that French, Acadians, free men of color, Attakapas, and Spanish people all owned cattle (Post, 1957). To a certain extent, working cows together proved to be something of an equalizing force for this mixture of races, classes and cultures.

Getting cattle to market required joint efforts as well. Early in the days of ranching, the cattle were driven *en masse* by horseback to markets in Baton Rouge and New Orleans. These trail rides were, again, collective, and required an elected trail boss. This trail boss was responsible for all trail operations as well as for negotiating a bulk

price for everyone's cattle. Some of the early trail rides to market would include thousands of cattle and would take up to two months under arduous conditions. In order for cattle to get to market, there were multiple routes, both over land via long cattle drives, and over water, using barges or steam boats, that the Vermilion Parish rancher would take. In fact, in a classic effort characteristic of their lives in old Acadie, in 1783 early ranchers in neighboring parishes taxed themselves to construct a better road on which to drive their cattle to the New Orleans market (Jones, 2007). These early days of raising cattle established a rhythm of working together in concert with the seasons and in response to subtle changes in the environment and society.

Coming to depend on open range and plentiful grass

The open range created this unique set of traditions. It also allowed people to own more cattle. In the summer, there is an abundance of sunshine and rain, and forage is plentiful and nutritious. In the winter, however, forage is in limited supply and it may require as many as 10x the number of acres per cow in the winter as it does in the summer to meet the nutritional needs of the herd. This seasonal rotation allows pastures to rest and fully recover for spring and summer grazing. In fact, it is an extended version of the modern-day best management practice called management intensive grazing. Additionally, close to this time cattle were sold east to markets in Baton Rouge and New Orleans for around $15-$20 per head, so collective grazing rights allowed ranchers to increase the number of head of cattle they run and be more profitable.

All this time, in the uplands of the Louisiana Chenier Plain, wild rice was growing in small circular ponds called *platins* (Post, 1957). The *platins* were good habitat for rice because the topsoil was gone but, like the rest of the prairie, still had a clay bottom that held water. The standing water would prevent other types of grasses, ones that are more

competitive, from growing and crowding out the rice. Near the turn of the century, the area was transformed into the major rice-growing area that it is today.

Into the Omega Phase

In the late 1880's, the Southern Pacific Railroad was built, connecting New Orleans to Houston. Soon thereafter, in the very early 1900's, "the rail and land companies attracted scores of immigrants in the early 1900's by advertising open spaces, a good life, and ideal land for growing grain. In less than a decade the old *vacherie* country was transformed into a prosperous rice producing area, populated by as many Yankees from the East and Midwest as by Acadians" (Bradshaw, 1991). This rice growing revolution took hold when some "northerners in the vicinity of Crowley and Jennings" (Post, 1957) started using the techniques used for growing wheat in order to grow rice. The plowing, disking, harrowing, planting and harvesting not only revolutionized rice growing, but it also open up the clay hardpan of the prairies and changed the grassland ecosystem. Most of this activity was in the northern portion of the parish, but some farmers in the southern half embraced this new technology as well. In this way, the technological cultures of the rice growers are reflected in patterns of landcover and landscapes.

And the Alpha Phase

Over time, cattle farmers began to see the value in rotating cows through their rice fields. In this way, the cows cleaned up the rice stubble and fertilized the fields, preparing it for next season's planting. This marriage of rice and cattle remains a common way to help make ends meet. During this alpha stage, the existing elements of the system reorganized themselves and emerged in a new, but recognizable configuration. In this case, the system of cattle ranching emerged from the disturbance of rice and

railroad by incorporating those new elements into its existing structure and, indeed, gaining strength from them.

TECHNOLOGICAL HISTORY: HISTORY OF HYDROLOGIC CHANGE

While cattle ranching was gaining, and subsequently losing its foothold in the economy of southern Louisiana, politics and private landholder decisions were slowly but surely altering the hydrologic regime of the marshes. There are various government and privately funded hydrologic projects dating back to the 1900's, but I will begin by explaining one man's fairly informed perspective on the hydrologic situation currently facing the Cheniers.

The marsh soils have a clay hardpan, with a layer of organic material that has formed on top of it. It is this organic material that provides nutrients, holds water and supports grass growth. The clay layer prevents water from percolating downwards. The organic material and the hardpan have no substantial interaction – they are not integrated soil types, but rather highly stratified. The only thing that actually holds the topsoil down is the roots of marsh grasses, known to dig as deep as the grass is tall under stressful conditions. Without these roots penetrating the clay, during a flood event the topsoil will literally float up, and, with the vegetation still intact, drift away. Now, since it is an unforgiving task for a root to dig its way into a clay hardpan, the only reason for them to penetrate it is in search of water. Without semi-regular dry spells, the topsoil will remain relatively moist, those roots will not dig any deeper than necessary to find water, and the organic layer will remains merely perched above the hardpan. This lack of root penetration makes the vegetation vulnerable to floating away during strong tidal action or hurricanes.

The canals that crisscross the marshes were all dug for various reasons, and at various points through the years. Although no one had ill intentions, it is these canals that were the first things to dramatically disrupt the natural hydrologic balance that created the marshes and the Cheniers. Canals allow tidal action and sea level rise to have a vast influence on water levels and salinity in the interior of the marsh. They keep the land saturated for significant periods of time, therefore loosening the marsh and rotting the roots.

These technologies were employed as tools to achieve a specific end, such as canals being dredged for transportation. Over time, however, they can produce consequences beyond what was originally anticipated, such as saltwater infiltration and marsh loss. This then requires new technologies, such as levees, to mitigate those consequences. In this way, the technologies become agents of change social and environmental change, and play a role in the shape of society and environment. (Winner, 1999 & 2000).

Once the canals were dredged, they mandated that there be management in the form of levees. Without the levees, soil saturation and saltwater intrusion were problems, and they were made worse by sea level rise. While for years it was legal and politically correct to build levees, the current regulatory environment is taking its cues from New Orleans and the rest of the Delatic Plain, where there is a different relationship to levees: "…when we try to get a permit to maintain the levee system to mimic the natural processes, [the policymaker's] education has been that of southeast Louisiana where the natural processes are…the flooding of the Mississippi, and not the ecology of the Chenier, which is vastly different. So, we just about lost that battle" (Interview, Feb. 2013). As discussed previously in this chapter, the deltaic plain is built up by regular flooding of the rivers, while the Cheniers are built up by sediment accumulation washed

up from the Gulf of Mexico. These very different processes are currently being regulated under the same set of laws and attitudes. This interview participant went on to say that "had the canals never been dredged – any of them – that sea level rise may only be showing along the perimeter" instead of affecting the interior of the marshes.

The Gulf Intracoastal Water Way, or GIWW, and Freshwater Bayou were both major Federal Navigation Projects. The canals, as told by the Louisiana Department of Natural Resources, allowed saltwater intrusion to occur. Over time, as the spoil banks eroded due to ship traffic, these canals became significantly wider and the intrusion problem was intensified. These two waterways, as well as the dozens of smaller oil and gas canals, dramatically affected the salinity and tidal characteristics of the Chenier Plain. In this way, the Chenier Plain, a historically north-to-south flowing freshwater to brackish estuary, was converted into a saline ecosystem with flows traveling laterally through the GIWW. The end results of these channels is the amplified influence of the tides and saltwater intrusion, increased land loss rates to erosive forces, wetland deterioration, excessive turbidity, ecosystem shifts from fresh to saline, and increased vulnerability to hurricane storm surges (Meselhe, n.d.).

In sum, the Cheniers of southwestern Louisiana are an STES. This means that the particular interactions of the environmental, the social, and the technological systems created an emergent system.

This emergent system is unique to southwestern Louisiana and is the foundation for a way of life, a Chenier ecosystem, and a strong oil and shipping economy. The environmental systems - the Cheniers and surrounding marshes - have helped create the social systems that developed in the area. The ever-present interaction of people and the marshes - though fire and grazing – created the grassy ecosystem of the Cheniers. Without the high ground of the Cheniers and these salt-tolerant grasses, the practice of

raising cattle in the marshes would not be possible. In turn, without the shallow soils and hurricanes that characterize the region, the land would almost certainly have been subject to the pressures of agricultural or urban development. The low lands of the marshes gave rise to levees, and far flung destinations on the Cheniers were accessed only through canals. In this way, the social systems also gave rise to the technological systems of canals, which then fed back into the environmental and social responses of saltwater infiltration and levees.

In short, the combined ecological, cultural and technological perspectives described are all different ways to describe one emergent system, located in Vermilion Parish, Louisiana. I used this as the background and context for the following chapters.

Chapter 5: Findings in Vulnerabilities and Adaptive Capacities

Systems with high adaptive capacity are able to, after experiencing a disturbance, reconfigure themselves without losing their primary functions. In this case, the system is that of cattle ranching in Vermilion Parish. The primary function of the system is to raise cattle on grass. As discussed in Chapter 3, a social-techno-ecological system with high adaptive capacity would be biodiverse, composed of a heterogeneous landscape mosaic, have social networks with institutional memory, be able to learn lessons from this memory, be capable of flexible problem solving, and be able to balance power

among groups of stakeholders. In more informal terms, these systems have to be able to roll with the punches. However, this research relates to *perceptions* of adaptive capacity – as in "do cattle ranchers, or others, *think* that they can roll with the punches?" If, as Kaplan and Kearney (1997) assert, "mental models guide people's perceptions, decisions, and behavior", and these mental models are composed of people's beliefs, assumptions, misconceptions, and what they consider to be facts, then perceptions of adaptive capacity can influence actual adaptive capacity. This combination of elements guides a person's decisions, actions, interpretations, and responses. Furthermore, as they go on to explain, people tend to ignore new information when it is contradictory to perceived truths or cannot be assimilated into their existing mental model, or paradigm. In an effort to know how and what types of new information would be integrated into people's decision-making criteria regarding increasing the adaptive capacity of cattle ranching, I must first understand their perceptions of the issue at hand.

As I go back through the many hours of interviews that I conducted in the spring of 2013 in search of people's perceptions of adaptive capacity, what they believe to be points of vulnerability and what they think of as threats, I came to the understanding that several factors may influence those perceptions. The first among them is whether or not the participant is, in fact, a cattle rancher. Secondly, I also assume that those with smaller herds who are more likely to have a second job may experience risk, vulnerability, and threats differently than those who only raise cattle for their income. The third, and, I believe, most significant factor in influencing a person's perception of adaptive capacity, is the location of their pastures in relation to the Gulf of Mexico, the marshes, and what is considered high ground.

During my fifteen interviews with ranchers and other types of experts, they collectively identified eleven specific threats and vulnerabilities. Many of these are

tightly intertwined or even directly overlap, and all of the participants identified multiple threats over the course of the interview. These codes can be loosely grouped as cultural, regulatory, and techno-environmental, with of course, significant overlap between the categories. The codes that I am describing as cultural are age, the next generation, money, and subdivisions. I grouped these as cultural not necessarily because they are cultural phenomenon, but because they become meaningful threats in the context of the cattle ranching culture. The regulatory group actually only has one code in it – policy and regulations – while the techno-environmental group is the largest. To a large extent, these codes and their definitions reveal some version of my own conceptual model regarding the topic as well and in turn affect the statistics I pulled from the coding exercise. For that reason, I will begin this chapter by defining the codes.

CULTURAL CODES

This meta-category that I am calling *Cultural* includes the ideas of age, the next generation, money and subdivisions as threats. Again, this is a meta-category comprised of themes that emerged during the coding of the interviews. I grouped them together under the Cultural umbrella because of their loose association with the way we live as a society and how society and cultures are changing.

Age

This "Age" category is tightly coupled with the next one, "Next Generation" and refers to the idea that ranchers are an aging demographic. I spoke with one rancher who was in his mid 30's, but the majority were in their 60's or older. To raise cattle in Vermilion Parish, and especially in the southern marshes, since it is such a unique environment with very specific difficulties and ways to address those difficulties, the cattlemen must inherit a set of traditions, or folkways that tell him how to do that. The

aging demographic reflects a vanishing knowledge, a reduced opportunity for the profession and associated ways to be passed down, thus decreasing its longevity.

Next Generation

The aging demographic is a threat, as discussed above, but in order to overcome the age factor, the next generation must be interested in learning about and pursuing ranching as a way to make a living. For the most part, the ranchers that I spoke with either did not know who would take over their ranch or they could only think of one or two possibilities. Many interview participants stated that the younger generation "don't want it. The young kids don't want it." and that they would rather work a fancy job in Lafayette or take a job in the oilfield where they could make some money and have a nice house. This reduction in numbers of practicing cattlemen and how it affects the industry as a whole is illustrated nicely by one rancher: "…a lot more people with less trailers than we used to have, back when I first started out." Because cattle ranching is such a communal activity and people rely on their neighbors for assistance in dealing with pulse disruptions such as hurricanes, when fewer people have equipment and no young (ie, strong) people have any "cow sense," then the remaining famers are more vulnerable. This represents a vanishing culture.

Money

Many participants expressed that making ends meet just raising cattle is close to impossible. Each of the interview participants stated that they and/or their wife or husband had to have another job outside of the home in order to make it financially. Several people stated that you don't raise cattle unless you love it, because you certainly aren't in it for the money. The financial aspect of threats to cattle ranching in Vermilion Parish actually occurred to me much later than the other threats. While most participants

shared financial information with me and related that there really is no money to be made in cows, they did not present it as a threat, per se. In keeping with the general feeling that ranching is a calling and that no one had much of a choice as to whether to do it or not, they presented the money side of the equation to me as merely the facts of life rather than as a question about whether or not they should continue to do it. Another part of this category, however, is the idea that some cattle farmers do, in fact, sell out and do something else. Again, because of the strong communal nature of the industry, this reduction in the number of people who know the way and can help when needed represents a threat.

Subdivisions

A few participants, mostly those in the northern part of the parish where there are already smaller tracts of land and a higher density settlement pattern, pointed out that subdivisions and "urban encroachment" are a threat to cattle ranching. In the patrimonial traditions of the area, the old ranching families were granted or purchased large tracts of land on which to make a living. Each time that land is passed down, it gets divided among the heirs. Several generations down the line, each great-grandchild may own 100 acres. However, since the younger generation may live elsewhere and is not as likely to use that land as farmland, many of them are selling the land to subdivision developers. This is seen as a threat because it reduces the amount and connectivity of potential cow pastures.

REGULATORY CODES

The *Regulatory* meta-category includes one code that refers to policy and regulations – local, state and federal – and how they impact the cattle ranching practice. I briefly outline it here, but get into more detail later in this chapter.

Policy and regulation

Policy and regulation is a broad category, incorporating everything from the politics of how restoration money is dispersed to the requirement for record-keeping and labeling requirements for ruminants. I grouped all of these together under policy and regulation because each of them individually would comprise only a very small number of statements. Among those identified policy and regulation threats are:

- ineffectiveness of federal disaster assistance programs
- the sheer volume of regulations surrounding "what kind of stuff you can put on your pastures, what you can worm your cows with, [and] cattle ID"
- state labeling requirements for direct marketed beef
- volume and types of state regulations and limitations on slaughterhouses for cattle
- wetland protection and mitigation requirements
- permitting process to build or maintain levees
- competing policies, regulations and goals within and between the federal and state government agencies
- dispersion of restoration funds to the "wrong" projects

TECHNO-ENVIRONMENTAL CODES

The following codes – flood and drought, hurricanes and storm surges, saltwater, canals, and levees – could be loosely grouped as both technological and environmental in nature. Along with the fact that they all have to do with the physical environment, there are common elements, or sub-themes that run through the environmental grouping. These include the expense of repairing damages associated with these events, how they affect vegetation and fresh water availability… Although these environmental codes share common sub-themes, I separated them into discreet ideas because I wanted to see if they could be correlated to ranchers vs. non-ranchers, higher elevations in the north of the

parish vs. lower marshes in the south, distance to the Gulf, or size of the operation. I will discuss these correlations in pages to follow.

Flood and Drought

Flooding and drought are different threats than hurricanes and storm surges. While a hurricane can cause a flood and a storm surge is sometimes referred to as a flood, a flood is also climate dependent. Freshwater floods, however, are caused by a different set of circumstances, and therefore management of it may be different from management of or planning for a hurricane. Droughts, the opposite of floods, are also caused by weather variations. Both of these affect vegetation availability, and repairing the damages requires significant labor and financial cost to the rancher.

Hurricanes and Storm Surge

All of the codes in this environmental group are closely related, but hurricanes and storm surges seem to be the largest, most all-encompassing category of threats. Hurricane damages are generally caused by high volumes of either wind or water combined with very little warning. The water could be in the form of rain, causing fresh water flooding, or in the form of a storm surge, causing salt water to be laid on top of the soil. A storm surge may push saltwater into freshwater lakes and bayous, thus accelerating the process of saltwater infiltration. Damages from hurricanes could be in the form of drowned or stressed cows, loss of fencing due to flooding, reduced forage availability, or lack of fresh water for the cows to drink. Expenses may be incurred in repairing fences, cost of moving cattle to higher ground either by trailer or 18-wheeler, the cost of diesel to pump water off of a pasture, or the expense of renting pasture elsewhere.

Saltwater

Salt is brought in through two mechanisms: storm surges, and tidal action. While storm surges bring saltwater in the form of an abrupt pulse disturbance, the ebb and flow of the tides can push saltwater up through canals, through a breach in a levee, and further inland than has ever been possible. This saltwater infiltration of surface water and freshwater marshes is closely tied to increasing tidal variation – from 12 hour tidal cycles to 4 hour tidal cycles, the deconstruction of an oyster reef in Vermilion Bay, and the construction of canals through the marshes, as well as the disrepair of certain levees that contain those canals. Saltwater intrusion can cause significant vegetation die-back when freshwater plants are rapidly exposed to high levels of salinity. This vegetation loss can increase the rate of erosion and subsidence as well as a reduction in the amount of forage available for cattle. Another ramification of saltwater intrusion is the resulting loss of freshwater for cattle to drink. Since the marshlands are "unimproved," there is no source of fresh water other than surface water. This problem was explained to me by one rancher as affecting his cattle because "salt water made their brain swell." In describing what happens when cows drink water after a hurricane has pushed salt water in, one rancher stated that "that water was so salty it would make them sick."

Levees

Levees are constructed for three reasons: the most common reason a levee occurs is as a by-product of dredging a canal. Canals are dredged for transportation in the oil and gas industry, for shipping, and as general access to remote parts of the marsh. When a canal is dug, the material that is removed is simply put on the side, forming a spoil bank, or informal levee. The second type is a protection levee. Many residents of Vermilion Parish are advocating for a protection levee all along the bottom portion of the parish to protect it from storm surges and, to a lesser extent, from extreme tidal action.

One example of a protection levee is the levee around New Orleans. While the state strongly considered this request, it seems to be a lower priority than many other projects. The third type of levee is built in order to create "pump-off land." Pump-off land is marshland that has been completely levied in and outfitted with a series of pumps. When this land floods, these pumps are turned on and the water is pumped off. The goal of pump-off land is to increase the amount of land available for grazing or growing rice.

Levees are, according to some, the easiest way to fix the problem of saltwater intrusion and protection from hurricanes. By constructing a levee, tidal waters and storm surges are, in theory if not in practice, kept off of the land. To others, these same levees are the reason that marshes are sinking, lakes are forming, and saltwater infiltration is occurring. Marshes are wetlands that are dominated by grasses instead of trees. They go through intermittent periods of inundation and drying. In fact, one interview participant argued that a maintained levee may be worse than an un-maintained levee. "Anytime you build a levee you stop surface and subsurface flow. And that's a disruption in the natural process" (Interview, Feb. 2013). Since marsh soils naturally undergo compaction and subsidence, which happens faster when the soil dries out, levees can disrupt surface water outflow and increase the rate at which marshland is converted to open water. In this sense, open water would mean a body of water with banks and a bottom that is always submerged. Levees can also prevent adequate inflow of sedimentation, which is the way that this natural subsidence is counteracted.

Canals

Canals are frequently straight waterways with spoil banks on one or both sides. Canals were first dredged in the marshes of Vermilion Parish by a corporation called Louisiana Fur, now Vermilion Corporation, in order to increase access to their large land

holdings. One respondent stated that prior to the access canals dug by Louisiana Fur, only a handful of natural bayous ran through the marshes. Since then, oil and gas companies as well as countless other government agencies and private landowners have dredged hundreds of canals. The marshes are now crisscrossed with canals at every angle.

Canals are a problem for three reasons. First, they dramatically alter surface and subsurface sheet flow. Second, canals are a straight, uninterrupted channel which is highly affected by the tidal regime. When the tide is going out, the canals will flow south into the Gulf, but with a northerly moving wind or when the tide is rising, those canals flow north, carrying saltwater into the middle of the freshwater marsh. The uninterrupted marsh grasses, with no canals through them, act much more like a sponge, absorbing and filtering the salty Gulf water. The third reason that canals are a problem is that they increase the surface area of land that is subject to erosion, thereby increasing the rate at which it occurs. Erosion rates are also increased by vegetation die off, which is then exacerbated saltwater intrusion and by the levees drying up the land. In short, when the first canals were dredged, they introduced the need for management of the land, and management at that time was conceived of very differently than it is right now.

Other

Other category includes things like encroachment of Chinese tallow trees

MORE DETAILS ABOUT THESE THREATS

This section will provide excerpts from the interviews that illustrate some of the responses, or articulation of perceptions regarding these threats. The perceptions that I highlight below are relevant in part, because they condition our expectations of what will happen. That, in turn, can create self-fulfilling prophesies. It is my intention to shed

more light on the nuances and details of each of the generalized categories that I presented above. After this section I will go on to look at the frequency of reporting and the spatial relationship between them.

CULTURAL THREATS

In the following passage, I allow the interview respondents to define and articulate the threats of Age, Next Generation, Money and Subdivisions. These cultural threats were mentioned 22% of the times that threats were discussed.

Age

The aging demographic reflects vanishing knowledge, a reduced opportunity for the practice and associated ways to be passed down, thus decreasing its longevity.

> *Resp. 6: You have a lot of older people who were in the cattle business along the marsh and south of here and things, the hurricanes comes through and… Just look at it this way: the hurricanes comes through when you're young person starting out with the family at 20, 25 years old. Started with cattle, we build this heard up all your life, when you get to be about 70, 75 years old, a hurricane picks up everything from you within two days. It's gone. Your fences, your house and everything. And this isn't something that was built up in a month or two months, this was something that was built up over a lifetime.*
>
> ---
>
> *Resp. 6: You had a lot of people when Rita comes through, were old. They were in their 70s to 80s. Still cattle people, in their 70s 80s. They didn't go back into the cattlemen business. [....] Because I don't know if you understand it or if you could understand this […]It's just very depressing. More than the common person could understand, of what they lost.*
>
> ---

Next Generation

The aging demographic is a threat, as discussed above, but in order to overcome the age factor, the next generation must be interested in learning about and pursuing

ranching as a way to make a living. Because cattle ranching is such a communal activity and people rely on their neighbors for assistance in dealing with pulse disruptions such as hurricanes, when fewer people have equipment and no young (ie, strong) people have any "cow sense," then the remaining famers are more vulnerable. This represents a vanishing culture.

> *Resp. 6: It's just you have a lot of older people pass away, and there's not a lot of young people that's coming back. I thought I was gonna be getting towards the older age, I found out I'm one of the youngest cattlemen. And I'm 59 years old.*
>
> ---
>
> *Resp. 2: […]and the older one said phew, I'm too old to get back in it and the young one say they have other jobs besides just raising cattle. So they said flip a coin, are we gonna raise our cattle or we are we going to keep our jobs?*
>
> ---
>
> *Danica: are your kids interested in ranching?*
>
> *Resp. 3: no*
>
> *Danica: who's gonna take over?*
>
> *Resp. 3: I don't know.*
>
> ---
>
> *Danica: So, do you think the next generation is going to have cattle?*
>
> *Resp. 8: They don't want it. The young kids don't want it.*
>
> ---

These passages show both the perceived disinterest of the younger generation and the effects of the dwindling culture surrounding that disinterest. When these perceptions go unchallenged, they are more likely to be fulfilled.

Money

Money is a problem for several reasons. The first is because of increasing costs and decreasing market returns. With growing need for land management techniques such as pumping water off of levied-in land coupled with the rising cost of diesel, the ranchers rely heavily on the price at the sale barn to make ends meet. Diesel, equipment (such as pumps, tractors, or fencing), feed, and recovery from other threats such as flooding or hurricanes constituted the biggest expenses for ranchers. Sugarcane was a topic that I lumped in with money because the respondents who identified sugarcane as a threat did so because of the price that sugarcane can command compared to cattle.

> *Resp. 9: It's getting harder to control [the water] by pumping. You have to pump more and your cost of pumping has tripled or more, when we used to pay maybe 17, 18, every 25 cents a gallon of diesel.*
>
> ---
>
> *Resp. 11: okay, after Rita I lost over half a million dollars over here, I had water way up to here.*
>
> ---
>
> *Resp. 11: It is very expensive to raise cattle now. With everything with the diesel and all that, so we are kind of lucky that the price of the cattle goes up you know? We've been averaging about $650 - $700 a calf whenever we sell and if we'd have to do it for $400, like we did two or three years back, I don't think there would be much...there would be no money made. You couldn't make no money.*
>
> *Danica: How low would the price have to go before you decided to just stop?*
>
> *Resp. 11: oh, about $350-$400.*
>
> ---
>
> *Resp. 1: and now sugarcane…makes more money. But it doesn't marry cattle at all. Rice and cattle go wonderful together but not sugarcane.*
>
> ---

Danica: How will you deal with the saltwater intrusion?

Resp. 3: well, we dug three wells like I told you the largest wells dug by that company that saved those people.

Resp. 1: When the hurricanes came, they could irrigate from their wells because the surface water was saline, it was salty. They couldn't use the waters from Intracoastal or White Lake, they had to use well water.

Resp. 3: we have three water wells... Not one, we have three of them.

Danica: Tell me how you handle the hurricanes with your cattle.

Resp. 3: well, because of my daddy being an engineer, it didn't cost me anything, and I built a protection levee around my 3,000 acres above the 100 year floodplain. Which costs a lot of money to do.

As illustrated above, the lack of money can also make other points of vulnerability more poignant. This last respondent considers himself "a very wealthy man." Not surprisingly, he also perceived fewer threats to cattle ranching and those he did perceive, he tended to apply financial solutions to. For instance, while he acknowledged that saltwater infiltration could render certain pastures unusable due to lack of fresh water for the cows to drink, his solution, a choice that was unavailable to any other respondent, was to have three very large wells drilled in order to pump fresh water to his pastures.

Subdivisions

In the patrimonial traditions of the area, the old ranching families were granted or purchased large tracts of land on which to make a living. Each time that land is passed down, it gets divided among the heirs. Several generations down the line, each great-grandchild may own 100 acres. When one of those great-grandchildren decides to sell

their share of the land to a developer, it takes that land out of production and eliminates the possibility of future production. This is also seen as a threat because it reduces the amount and connectivity of potential cow pastures.

> *Resp. 5: The more that the subdivisions come up and let's say younger people acquire some land, they're gonna sell their piece. They're not gonna keep it. Younger generation ain't gonna keep pasture land. They're gonna sell it.*
>
> ---
>
> *Resp. 6: the biggest threat to cattle ranching in Vermilion parish is urban encroachment*
>
> ---
>
> *Resp. 6: Okay, my grandfather, when he passed away he had a little over 700 acres of land. He had two sons. Okay, that's divided up, let's just use 800. So that's divided up 400 each. My uncle had four kids and my daddy had four kids, so that's divided up again. That's each 100 acres. Well some of them don't want to keep their land for farming, they just don't want the hassle of it. I just want to live in an apartment house, I don't want to mow the grass, I just want to go to work, I'm gonna come home, I'm gonna get on the computer, I'm gonna watch Netflix, I'm gonna watch whatever. I don't want all the hassle [of ranching or maintaining agricultural land].*
>
> ---

This ties in very much with both the next generation's enthusiasm about ranching or farming as well as the sugarcane threat.

POLICY AND REGULATORY THREATS

The category of threats that I deemed *Policy and Regulation* includes a wider range of concepts than any of the other categories. In this section I will attempt to articulate and summarize each of these and provide direct quotes from the interviews to support them. One significant theme in Policy and Regulation concerns environmental regulations. First there is the perception that different agencies within the State and

Federal government, and indeed that the State and Federal governments themselves, have conflicting agendas. This is significant because the governmental in-fighting is hampering the ability to get restoration projects done. It also alludes to the next category, or the idea that environmental regulations are at odds with the goals of cattle ranchers and others who live off the land.

The following passage illustrates the feeling of conflict between state and federal governments and between agencies:

> *Resp. 1: The federal government and the state government and aren't cooperating. […] You have competing agencies. U.S. Fish and Wildlife, National Marine Fisheries, the EPA and Soil and Water Conservation District… And they often have competing views.*
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> *Resp. 2: I serve on the board [of the Soil and Water Conservation District]. We are trying to get USDA and they're coming along with us: NRCS, USDA. They're trying to work with us because they are stewards of the land just like we are, trying to help us - but you've got these other federal agencies that are bucking us.*
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There also exists a perception about environmental regulations as hampering ability of ranchers to take care of themselves. The requirement to get a permit to do a marsh restoration plan, to build a levee that would protect them from hurricanes, or do anything that would affect wetlands makes people feel less ownership or ability to take action to care for the land the way they see fit.

> *Resp. 2: I'm fighting with them now because that's part of my management plan. I shouldn't have to get another permit just to fix [the levee on his land]. They kind of agree with me, but they haven't sent me a letter saying I can do it.*
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> *Resp. 11: So one day I woke up, I said: Man, I'm going to build me a levee. I said I ain't going to lose that no more. So I had some tractors, I had two backhoes on my land, I took off and I built all this levee all for forty acres, I built a 15 foot levee all around the forty acres. All that dirt, it's me that hauled that, and I knew*

after I finished, they wouldn't give me a permit to do that because of the wet zone, you know, so I said I'd do it anyway and whatever happens, happens.

Regulations surrounding land management techniques are a source of frustration and are considered a threat to the environment. It refers to the idea that the way land is allowed to be managed by the government is not context sensitive. Instead, the regulations that are put in place for the Deltaic Plain are then inappropriately transferred to the Chenier Plain. The best examples of this are the rules surrounding building and maintenance of levees and dredging canals.

Resp. 13: On every incoming tide, you enter water and you enter a little bit of salt, but you don't have the rich sediments that the southeast Louisiana has. But the regulatory community doesn't recognize that. So they make it very difficult for you to repair your levees and they frown upon that kind of thing. So when we try to get a permit to maintain the levee system to mimic the natural processes, their education has been that of southeast Louisiana where the natural processes are the natural body use, and the natural flooding of the Mississippi, and not the ecology of the chenier, which is vastly different. So, but we just about lost that battle. That marsh around Freshwater Bayou may never, probably will never come back.

Resp. 13: The levees and canals go hand-in-hand. The regulatory guys, okay, the regulatory guys see the canals and the levees and they see the levee as the unnatural thing...never occurs to them that the canal is an unnatural thing. In the hydrology of the marsh, they see the levee as impeding the sheet float on the canal.

Resp. 2: I did a marsh management plan in 1990 or 98, but it took me right at one year to get a permit. Just to get a permit.

Danica: A permit to do what?

Resp. 2: To do the plan. Just to do the plan. That's not doing the plan, that's just to get a permit to do the plan.

Also in the political realm are Federal and State regulations around small farms, including direct sale of beef off of the farm and labeling requirement for farmers markets as well as those relating to the number of dollars worth of beef that a slaughterhouse can process for restaurants. This was a topic that was mentioned by a few respondents, but was talked about most extensively by the respondent who raises grassfed beef and sells it off the farm. Over the course of the conversation, the respondent moderated her attitude somewhat. Other respondents mentioned regulations as one of several barriers that prevented them from moving to a grassfed system instead of selling 500lb calves at the sale barn.

> *Resp. 7: In the context of cattle it's really dumb that they do it in… The regulations I'm familiar with, for instance, if I understand it right, the slaughterhouse I use can slaughter X dollars worth of meat for restaurants. You know they're licensed to process X amount of meat for restaurants. But it's in dollars. Why wouldn't you do that in pounds? Or even the number of animals?*
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> *Resp. 7: Finally he said okay– and he showed me a volume 2 ½ inches thick – this is the addendum. This is not the regulations, this is the addendum. The regulation is several volumes.[…] You know if someone were to come in here and say you can't sell, you can't sell that beef. I would quit. You know, it's not like I'm making money off of this.*
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> *Resp. 7: Mike Strain understands his role as agricultural Commissioner is to promote Louisiana products. Or, that is an understanding that he takes of his role that I admire. I think he does a great job of it […] It went from being a system to where you couldn't even get anyone to talk to about it to being a system to where he has someone in his office and when other producers asked me I can give them her name they can contact her she can tell them clearly what they need to do. They can get it together, they can send it to her, they can pre-approve it. […] You know, you have to print the labels, but there are not exorbitant costs or fees to be able to do it. It's really one of the few agencies, now that I think of it, government*

agencies that is supportive of the industry they are supposed to be representing rather than raping it.

There are government assistance programs, such as EQUIP, that are designed to help ranchers pay for fencing and other necessities when trying to rebuild after a disaster. For many ranchers, if they have any cows left standing after a disaster, this program is the only way they would be able to begin ranching again. However, the level of paper work and upfront costs associated with it proved to be prohibitive to many in the older generation.

Resp. 2: EQUIP is a program within the USDA. Well there's practices within USDA that'll help you build fences. They won't build your perimeter fences, but they'll build your [interior] fences. Well, after the storm all the fences… if they were EQUIP fences, USDA would replace your fences. You had to build them, but they would pay you for the material to rebuild your fences. Well it's like all bureaucracy, you know, you got to sign up for it and if the money's there then they let you go build the fences, but you can't start building the fence until all of the papers are signed and so I guess the older generation said "well look, this is more trouble than it's worth and we ain't got the money to pull out of our pocket to go do it." So they just never would fool with it. But the fence was a big thing.

TECHNO-ENVIRONMENTAL THREATS

This category is the most complex in many respects. Conversations about the issues of saltwater, hurricanes, flooding, canals, and levees incorporated a blend of local ecological knowledge gained from a lifetime in the marshes, recent scientific information, cultural attitudes about responsibility, and political opinions that are influenced by trust in government. These categories all overlap and intertwine and I will attempt to separate them by topic, however, as you read through these snippets of conversation, you will notice that each topic is always discussed in concert with one or two others.

Flood and Drought

Flooding from rain, although more common than flooding from storm surges, is considered less of a threat than any of the others in the techno-environmental category. However, both flooding and drought can still cause a significant disruption in forage availability. Flooding is also expensive, given that it requires diesel to pump off the pasture and may require fence repair. One of the most commonely referenced floods is the flood of 1940 when it rained 40 inches in 40 days. All floods since then are compared to that one.

> *Resp. 12: my grandfather's deceased, but he was born back in '27, and besides the flood of '40 where it rained for forty days and forty nights, they had never seen …*
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> *Resp. 11: So we were almost flooded almost like a storm about 2 or 3 weeks ago whenever we got that 10 inches or 15 inches of rain, so we had to move a bunch of cattle out and we had to do a whole bunch of stuff just like a storm, but I moved them more into the Gulf because the Gulf the tide drops like this over there.*
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> *Resp. 12: Before, that big rain took a toll on the cattle – all of them went down, I mean they probably all lost like a hundred pounds - two hundred pounds maybe in those couple of weeks, then they come in with babies.*
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> *Danica: a hundred pounds, because of the*
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> *Resp. 12: oh, 'cause it was like 12 inches of rain like two days*
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> *Danica: Is it just 'cause they didn't have the grass?*
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> *Resp. 12: Well, no, they just, I mean they're out there you know just their body temperature goes down, they're not out eating like they should you know, they're just staying there. Their body condition goes down fast, when the weather gets messy like that.*
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While heavy rains, flooding and drought rarely result in loss of animals, the stress associated with those events can lead to decreased body weight, which is the currency of the cattleman.

Hurricane

Almost all of the other sections in the techno-environmental category overlap with and touch on hurricanes, but this section, more than any other, was emotional for people. Hurricanes lead to death of cattle, reduced forage availability, loss of fencing, saltwater infiltration, and damage to roads and homes. I heard many stories about near-misses and total loss, as well as stories about the emotional and financial expense associated with recovery from hurricanes.

> *Resp. 2: See when the storms came in, we all suffered. I personally lost 150 head of cattle. Drowned. You have an event like that, it not only kills your cattle, it stops you from getting back in the cattle business because salt water gets onto the land and kills the vegetation. Its not like getting around the table and eating, you know, the cows gotta have a place to eat.*
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> *Resp. 9: You see for one of those storms in the past I lost quite a few cows.[…] The current was so strong going down that a lot of those drowned animals were flushed out to the Gulf. I have a couple of friends that were working on rigs out in the Gulf and they say you can't imagine the number of carcasses that would float up against those rigs.*
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In addition to the death of animals and direct losses, hurricanes can make a lot of work for a rancher. Once it becomes evident that a hurricane might make landfall close to Vermilion Parish, the cattleman has only a few days or hours to move their cows to a safer location. They first have to secure a pasture further north and make sure that it has forage or hay available, then they have to round up their cows, load them on trailers, and

drive them to the pasture. During the hurricane, ranchers in the south will spend their time making sure that the pumps are working properly and the water is getting pumped off. Afterwards, the pastures need to be dried, the fences repaired, and the cattle sorted according to owner before being brought back south. In some cases this may take weeks. If the ranchers were not able to get all of their cows out of the way ahead of time, the weeks after the hurricane will be spend looking for them, trying to round them up and get them to a pasture with available forage.

> *Resp. 8: The four days before the hurricane until 6 weeks after the hurricane, I worked on hauling back every morning. We had sometimes 8-10 trailers in my yard, and we were rounding up cattle for people. Depending on where the pens weren't tore up, we would take them to those pens and we'd sort them. Some would go to the sales, some would go back to some pastures, some we shipped to the northern part of Louisiana where the storm hadn't hurt us so bad. We did that for six weeks!*
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> *Resp. 8: It just so happen, I was coming back from the stockyard and they said that hurricane was coming this way. That night I got on the phone and I called Dago and everybody that I knew that had cows in low area and we went and check my cows in Intercoastal and we came back and we went pick up Dago at Intercoastal and we had some at the Queen Ranch, we picked them up and brought them up to high land.*
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Ranchers have noticed that over time, the effects of the hurricanes have gotten larger and their local knowledge of high ground or safe areas is no longer true.

> *Resp. 5: so when we had [Hurricane] Rita, we move [cattle] just past my house where we thought it was high, but for Rita it wasn't high. For Rita we had to go out to the edge of the parish, out by Abbeville or North.*
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Resp. 6: They say if's a [Hurricane that is a category] five came through like [Hurricane] Rita did, […] they claim we would have water almost to the interstate.

To a large extent, the ranchers were hesitant or unwilling to hazard a guess about why the hurricanes were increasing in strength, frequency or why the impacts of the storms were getting worse. When asked, most respondents would give very general answers, however two respondents were willing to speculate.

Danica: What has made the storm surges worse over the years?

Resp. 1: Two things: the coastal marsh loss and the actual moving north of the beaches and the loss of the barrier reef system.

Resp. 12: Those hurricanes came up and they said it's because our coast is messed up…

Resp. 1 was then able to go into detail about how the oyster reef in the mouth of Vermilion Bay impacted the tidal regime and the subsequent impacts once that reef was mined. Once the oyster reef was removed, the flow of water into and out of the Bay was unhampered. This meant that during a hurricane storm surge, the water rose higher and faster than ever before.

During a hurricane, the older generation and those with large herds are most vulnerable to suffering significant losses. The ranchers with large herds are also most likely to be located in the southern part of the Parish where the hurricanes are stronger and the storm surge is uninhibited.

Resp. 12: You might take 30 or 40 cows and move them somewhere, but some of them guys have four, five, 600 head of cattle and there was no place to go.

Danica: So, the larger the cattle producer, the less flexible they are in terms of dealing with flood and hurricanes? Like, the small ones, they don't bring their cattle down south. And so they are not as susceptible to being damaged?

Resp. 1: No, that's right.

As people who make their living off the land, ranchers are sensitive to changes in their environment. The local economy depends on those that are vulnerable to fluctuations in weather

Each hurricane or disruption is met with social cohesion and a unified effort to help each other out and keep the cows safe.

Danica: Can you tell me how you handle hurricanes and storms?

Resp. 11: Oh, I'm lucky I got some good friends!

In sum, losses from hurricanes are expensive, emotional and they are a lot of work. Over the lifetime of many respondents, the storms have increased in frequency and in strength, but the reasons remain unclear to ranchers. And, although ranchers are currently physically and financially vulnerable, the traditions that emphasize social cohesion in response to hurricanes help move the system past these disruptions.

Saltwater

Saltwater was discussed by all except the two ranchers located furthest north. The common reasons that saltwater is considered a problem are that salt kills the available forage, cows cannot drink saltwater, instances of saltwater infiltration are increasing, and that infiltration contributes to coastal land loss. On the other hand, some respondents pointed out that saltwater is not entirely bad. One respondent went so far as to declare that the *perception* of saltwater as the problem was, in fact the problem.

Resp. 2: The cattle ranching business in Vermilion Parish since Rita has dwindled.

Danica: Why?

Resp. 2: Salt water intrusion

One very real problem with hurricanes is the saltwater that is brought in during the storm surge will kill any grasses that are not saltwater tolerant. Most marsh grasses are able to tolerate, and even thrive within a range of saltiness, but the regular forage crops that are found in the middle and northern parts of the parish are not at all salt tolerant.

Resp. 5: [The saltwater] killed everything. The saltwater came. The ocean came up on land and killed everything.

Resp. 9: in order to have your vegetation you have to have your levees and your levees protect you from salt and water.

The Cheniers, ironically, can serve as a refuge from the aftereffects of a hurricane. The Cheniers are higher in elevation than the surrounding marsh, so the cows can stand on solid ground, and the vegetation thrives in the brackish conditions. So, while the storm surge may kill the vegetation on high ground, the grasses down south are still growing.

Another problem associated with saltwater is that of saltwater infiltration into the surface water. Since cows in the marshes are dependent on surface water to drink, the saline tides that are increasingly pushing salt into the freshwater supply are posing a threat to grazing areas that would otherwise provide plenty of land and grass.

Resp. 2: The problem we're having right now is that it goes back to saltwater. You see the cattle drink in the natural streams and the canals, and whatever it is in the marshes. […] you have beautiful grass out there right now, but I got no water for them to drink. And the way we call it in Chenier au Tigre, we're in a deadlock. You got a bunch of saltwater that goes back up in there, you can't get it out. Because there's no circulation. When the tide goes out, that water goes out and when it comes back and it's just pushing the same [saline] water back in.

Resp. 11: Well, you have to put them some fresh water, they can't drink that saltwater. They can drink a lot of salt, but it messes up their stomach and if they're pregnant they could abort a dead calf.

According to several respondents, saltwater is more widespread now than it used to be, and the ramifications range from killing forage crops to reducing available drinking water, to importantly, increasing rates of coastal land loss or landcover change.

Danica: so why is the saltwater getting in more now than it used to?

Resp. 2: navigation channels mostly. Our biggest detriment to the wetlands in Vermilion parish is Freshwater Bayou, Intracoastal Canal, and the Four Mile Cut. That's all navigation channels. ---

Resp. 2: We're also looking at tidal altitude and tidal flux. Years ago, I give you an example, at the Audubon camp it would take 12 hours from high tide to low tide. And vice versa. Now it's about four hours.

Danica:Why?

Resp. 1: Because this big opening between Marsh Island and Point aux Chene has changed the tidal fluctuation in that whole basin. Instead of having one pass with one channel, now you have an opening 34 miles long.

Resp. 2: [The tides] create a pumping action. The water comes up and it goes … right back out, it's like pumping. And it pulls any loose material,any kind of vegetation that's affected by the saltwater, it's pulling the salt with it. You can go to Tom's Bayou fishing and if the tide's going out you can see some of the marsh going out with it.

Resp. 12: Saltwater's killing some freshwater marsh because of saltwater intrusion. You see, when saltwater takes over a place, the first thing it normally does is kill three fourths of the vegetation.[…] None of the marshes look like they used to look, and I'm only 32 years old.

Although to a large extent, salt and saltwater infiltration were seen as real threats, threats that respondents were willing to take action against, there were also those that, in the next breath, spoke about how saltwater may not be as bad as it is widely considered. One respondent pointed out that the common liver fluke parasite is killed by saltwater and that the saltwater, while presenting the obstacles listed above, could also be seen as a cleansing force or an opportunity for renewal.

Resp. 4: Liver flukes cannot tolerate salt water.

Danica: So what happens when the saltwater comes up?

Resp. 11: It brings all the saltwater out of the Gulf and brings it on the land, then it's so flooded, the cows have nothing to eat so you got to take them out, they drown or whatever. The saltwater is bad for the grass, but it's good, it makes that blue grass come up good. It's not as bad as we think, you know? We live with it, you know.

Finally, I will present an alternative to the idea that saltwater is a threat or even just something that "we live with." One respondent went so far as to say that not only is saltwater not a problem – there has always been salt in this area – but the widely held perception that saltwater is a threat is the real problem that needs to be dealt with.

Danica: So you said that saltwater intrusion is a myth?

Resp. 1: Oh, yeah

Danica: So the perception that saltwater intrusion is the biggest problem, is the biggest problem?

Resp. 1: [That perception is] the biggest problem. Because we do everything to stop saltwater intrusion, and you know saltwater intrudes every high tide, and leaves every low tide.

Resp. 13: You hear salt and I keep telling people in our area anyway, it's not as much about salt as it is about this tide and the inability of the land to dry out, you know. This country can take a lot of salt.

Resp. 1: It all turns on this issue of "we got to stop saltwater intrusion"

Danica: And that's why they're building levees?

Resp. 1: That's why you build levees, and the high tide is the enemy because it overwhelms the levees. And the fact that you dry it out for it a period, you consolidate the soil, and it sinks very fast. The levied in area, subsidence goes up by a multiple of 10.

Danica: Because there is no inflow sediment?

Resp. 1: Because the drying consolidates the very loose organic material. Because it's naturally wet. So when you levee it off and you pump it off, you dry it out and it sinks like a rock. Instead of sinking at three or 4 mm, it sinks 30 mm.

This respondent asserts that the steps that are taken to combat saltwater intrusion cause more problems than saltwater itself. By this person's account, the increased land management in the form of levees, gates, dams, dykes, and canals are far more disruptive to the local hydrology and therefore far more problematic.

Saltwater, as seen by the respondents, can cause loss of food for the cattle, undrinkable surface water, it can intensify coastal land loss. Despite all of these

concerns, some respondents noted that saltwater has always been prominent in the coastal area and that it not only kills the liver fluke parasite, but that native coastal vegetation has a certain level of saltwater tolerance. Therefore, traditional cattle ranching in Vermilion Parish has incorporated some work-arounds for saltwater – such as bringing the herd to the coast where saltwater tolerant grass species live. Additionally, as one respondent pointed out, the steps that residents of the parish take to reduce the occurrence of saltwater related problems may, in themselves, cause more significant problem, or even increase the instances of the saltwater problems.

In the next section, levees will be presented as a necessary evil – an intervention in the natural hydrology that, while possibly detrimental, are also required to offset the effects of the canals, whose existence are largely taken for granted.

Levees

In this section I will present the respondent's perceptions of levees and their impacts on the surrounding marsh. Levees are characterized as causing subsidence as well as solving the problems associated with canals. Despite the negative consequences of building levees, they are still used for a number of reasons. The following passages show that levees are sometimes used to increase usable pasture by creating pump-off land.

> *Resp. 1: if this pasture when out from the bridge say 300 feet, they would put a levee that goes out 800 feet and capture more of the land and then pump it, and drain it, and make more pasture.*
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> *Resp. 3: The protection levees, of course, are the key factor for us in surviving. Without it, we'd be like our neighbors are, they're in bad shape. But my daddy engineered it, he [built levees] in the hundred year floodplain.*
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Since canals are conduits for saltwater and tidal surges, levees are sometimes used to protect the marsh and surrounding pastures from the canals.

> *Resp. 5: On the intracoastal Canal, when I was a kid, we used to go burn the marsh like I told you… When we was on this side, let's say this is the intracoastal and they had a levee, and we would get down on the side and burn it. We could hear the tug passing, but we could not see that tugboat. And that tugboat is high, I mean maybe 35 feet. You could not see it with that big levee … So we would run up the levy said they would blow their horn. Right now, the ain't no levee. It's just like the marsh - its flat.*
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> *They're all related, you have to have your pastures to start with, then you have to have the right vegetation, in order to have your vegetation you have to have your levees and your levees protect you from salt and water.*
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Protection levees are seen as a defense against the problems that we cannot control – hurricanes, storm surges and floods. There has been a proposal, taken seriously by the federal government, to build a long protection levee across the bottom portion of the Parish. This would protect the northern part of the parish from the effects of hurricanes. On a smaller scale, one respondent even built a levee around his property to achieve the same type of protection

> *Resp. 8: a protection levee [along the bottom part of the Parish] would be the ideal, I think.*
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> *Resp. 9: The government was trying to put up some […] flood protection levees, but they are having trouble getting together on where to put the levees and of course you have to pay for the levees and they're having trouble with the [Army Corps of Engineers] also, you know.*
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> *Danica: So where do you think the levees will be most effective?*

Resp. 9: [The further south] you can get them in, the better off we'd be out on the coastline

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Resp. 11: okay, after Rita I lost over half a million dollars over here, I had water way up to here … So one day I woke up, I said: Man, I'm going to build me a levee! I said I ain't going to lose that no more. So I had some tractors, I had two backhoes on my land, I took off and I built all this levee all for forty acres, I built a 15 foot levee all around the forty acres. All that dirt, it's me that hauled that, and I knew after I finished, because they wouldn't give me a permit to do that because of the wet zone, you know, so I said I'd do it anyway and what ever happens, happens!

Resp. 11: The year Ike came, I was dry like this! 20 miles all the way around this, 20 to 30 miles it was flooded with water. The only dry spot was over here because of my levee.

Unfortunately, levees need maintenance, and maintenance is best done by the government. The failure of the state to maintain the levees was seen as one reason that the impacts of hurricanes and the storm surges have gotten worse in recent years. Respondent 5 declared that the reason Hurricane Audrey in 1957 was not as damaging as Hurricane Rita in 2005 was because of the levee along Intracoastal Waterway.

Resp. 5: So that's why: it eroded; all the boats, traffic eroded it and push it back into the intracoastal Canal. If they would put some rocks along the intracoastal Canal, high, 35 feet,they wouldn't have had no water here. They didn't have no water for Audrey. They had a little, but they didn't have a lot. Not like this kind of thing where was past Erath, almost to Lafayette. Everybody here knows that's what they need. All they need to do is put a 35 foot levee of rock or of dirt along the Intracoastal. Everybody knows that. But that will never happen.

Resp. 11: They used to have some big old levees and then now they got no more levees.

Danica: And why did they erode?

Resp. 11: Because of the boats back and forth, back and forth, back and forth in there and they never fixed it.

Resp. 13: The levees weren't bad, you understand? The levees weren't bad. The only time the levees became a problem was when they failed and we weren't allowed to fix them.

The following excerpts illustrate the idea that, as a direct result of building a levee, the land subsided, compacted, consolidated, or, essentially, sunk. These were seen as simply the price to pay for the protection of the levee, and able to be managed through consistent management of the land.

Resp. 2: All of the ranchlands that Dr. Miller had leveed in years ago, after poor Dr. Miller died, they didn't take care of the levees. And any time you levee in a piece of marsh, the soils consolidate. And they compact and they go down. So whenever they didn't take care of the levees, water just came in and all those pretty pastures that were there before were lower, so they just made lakes.

Resp. 1: The levied in area, subsidence goes up by a multiple of 10… because the drying consolidates the very loose organic material. Danica: So, when you say he reclaimed that land...

Resp. 9: You put a levee around it and you dry it out.

Danica: But because they put the levee around it and dried it out...

Resp. 9: ...it causes it to recede more than normal.

Danica: and so are the levees causing the problem?

9: Well the levees correct one problem, but in correcting the flooding problem, it causes that land to recede. […] Let me put it this way... flood control gates are not as effective as they used to.

Danica: Why? Are they designed differently?

Resp. 9: Because your ground is getting so low to where they are ineffective. Your normal tide is above the ground level now.

Danica: And so now what we are seeing is that there was some flooding, and so you put up a levee, but because of that levee, the ground sinks, and now it floods worse.

Instead of conceptualizing subsidence as the problem, during the conversation the above respondent characterized the landowner's failure to maintain the levees as the problem. He considered subsidence to be something that a landowner should control by maintaining the levees instead of something that should be avoided.

In that they disrupt the natural hydrology, levees affect the habitat of everything from whooping cranes to commercial fisheries.

Resp. 1: See, [the levee] had a big impact on the whooping cranes. Because whooping cranes, their principal food was juvenile blue crabs. But when you build this, it blocks the blue crabs from coming in and reproducing....

Levees are seen as savior and as threat; they are a necessary evil, needed to be able to mimic the natural hydrology of the marshes. Levees are used to create pump-off land and extend the range of usable pastures. They are also used to protect the land from the salty tides and storm surges that rush into the canals. Levees are used as a defense against hurricanes – both on a parish scale and on a much smaller scale, as around an individual's property. Despite all of these benefits that my respondents saw, levees need maintenance. Maintenance is expensive, and best done by the state or federal government, but without it, none of the benefits can be realized. In fact, because levees also increase the rates of subsidence, once the levees cease to be maintained, that land is in an ecologically compromised state and will more easily convert to open water.

Canals

Canals have been dredged for many reasons and by many people. The first canals that were dredged, as asserted by one respondent, were by a corporation called Louisiana Fur, now called Vermilion Corporation. Since boats were the easiest form of transportation, these first canals were dredged to facilitate access to the Louisiana Fur land holdings and clubhouse in Belle Isle. Later, canals were dredged by oil and gas companies to gain access to drilling sites and to lay pipeline. The tradeoff for this increased access was the subsequent need for "land management," or use of levees to control salinity, subsidence, and hurricane impacts. This dependence on man and technology to maintain the same salinity levels as before the canals indicates a regime shift in the coastal ecosystem.

The following passages illustrate some of the reasons for dredging the canals.

Danica: [To summarize what you just told me], because they wanted access for all this amazing land they had, they had to dig some access canals. [… and they] increased the amount of management needed on that property.

Resp. 13: Right, because there was no management before.

Danica: If they had never dredged the canals then they wouldn't have to manage the tides or the water levels?

Resp. 13: That's right.

Danica: But as soon as they dug those canals to get access, then they somewhat had to manage it.

Resp. 9: Everybody wants oil, you know and we're very much interested in it, but in the past they dug all these access channels to put wells along the Intracoastal and along the lower part of the parish, and then those access channels had never been stopped up... It's a good thing, a real good thing it brings revenues to the parish, but it doesn't help the flooding situation.

The marshes of southwestern Louisiana have very few, if any, naturally occurring canals or bayous. When a canal is dredged, the hydrology of the area is disrupted. While the marsh evolved with water passing through it in "all kind of wiggly ways" (Interview, Feb. 2013), when a canal is dredged, that water makes its way to the lowest point – the canal – and then bypasses the slow, roundabout path that it would have taken.

Resp. 1: one of the most destructive things you can do to the wetlands is build a canal

---

Danica: So what was the area like before they ever dug Freshwater Bayou?

Resp. 2: It was nothing but lush green marsh.

Danica: And so why is it that when they dug it, it changed?

Resp. 2: It changed because you changed the hydrology.

Danica: I'm not a hydrologist, explain this to me, help me understand.

Resp. 2: Okay, water, the good Lord up there built this thing to where this water passes here and this water passes there, it may pass all kind of wiggly ways but this is the way it was designed to pass. But whenever you dug a straight canal, you cut off that water that normally would drain naturally, everywhere where it was suppose to drain.

Resp. 1: [The canal around Rockefeller Wildlife reserve] screwed up the hydrology of the reserve. With a canal! They built a big ass, oilfield type canal. 100 feet wide, 10 feet deep to define the boundaries so you wouldn't trespass on it. To make it easy to patrol. 38 trappers left the marsh the season after that happened. Every trapper that trapped in the marsh, left. Do you know why? There was nothing left to trap.

Because these canals are straight lines that lead from the Gulf of Mexico into previously isolated areas of the marsh, canals are conduits for saltwater, tidal water, and

water from hurricanes. These straight channels provide to unhampered means for storm surges and tides to bring saltwater in, resulting in vegetation die off and coastal land loss.

> *Resp. 9: You know, the lower part of the parish has been improved by good drainage. Improving the drainage system and of course by the same token it helps get that water out, but in turn it helps it brings it back in when you have adverse weather conditions and the tides beginning to affect us more and more because the tide comes up much faster. Used to, when you didn't have all those improved drainage, it would take longer for that tide water to come in. Now with a strong southeast wind, that water comes in much faster and it affects a lot of that cattle land that we use to graze.*
>
> ---
>
> *Resp. 9: The result is it brings saltwater a lot faster to us. It worsens the storm conditions.*
>
> ---
>
> *Resp. 12: Supposedly that freshwater channel that they dug is causing a lot of our problems.*
>
> ---

Once these canals were dug, they needed management. To prevent the canals from widening, they needed to have their banks and levees stabilized. Additionally, without this maintenance and stabilization, the marsh would be subjected to the ebb and flow of the tides.

> *This is the intercoastal canal. See the intercoastal canal how small it is at that time. It was about the size of the Vermilion River at that time. It's much larger now.*
>
> ---
>
> *Resp. 13: ...from the dredging of Freshwater Bayou until about 20 years later, we were able to still mimic the natural system of drying the marsh and it would go through a dry period and the marsh stayed good and healthy. In the last 10 or 15 years, we have lost all water control in those marshes*
>
> ---

Canals were seen by a few of the respondents as responsible for other threats – saltwater, levees, and hurricanes, for example – but they were also generally regarded as a feature of the landscape that was there to stay. In other words, it almost didn't matter to many of the respondents whether they would consider canals to be the "real" threat because there was nothing that they would be able to do to correct the problem. In these respondents' eyes, the actionable items were levees – they could lobby the state to build or fix levees; and saltwater – they could build levees or saltwater control gates.

Each of the codes I discussed in this section are generalizations of very complex, nuanced perceptions of threats and vulnerabilities associated with cattle ranching in Vermilion Parish. Each simple idea – the threat of the aging demographic, for instance – is a broad statement of concern that ties together the changing culture, politics, mainstream society, and the environment that we exist within. By incorporating snippets of my interviews and allowing the respondents to speak for themselves, I attempted to demonstrate how each individual perceives these ideas slightly differently. The perceptions of truth are, to a certain extent, self-fulfilling prophesies. For example, if many farmers think that canals are non-threatening but that saltwater is the issue of primary concern, then they will continue to advocate for levees and continue to not address the complex web of canals that criss-cross the marsh. As I will discuss in Chapter 6, these multifaceted threats require equally complex and intricate solutions.

In the next section of this chapter, I broke down the frequency that each of these codes was mentioned and related it to geography or to social group.

CODED INTERVIEW DATA FREQUENCY

In this section I looked at the frequency which a code was mentioned, what percentage or share of the overall codes it represents, and the frequency of each meta-

category, or group. I generally found that techno-environmental codes such as hurricanes and saltwater topped the list in perceived importance, and that subdivisions were mentioned least. Following this analysis, I looked for patterns of threats that varied by the respondent's relationship to cattle ranching (whether they were or were not a rancher), the size of their herd, and their location in relation to the Gulf Coast. To further analyze the spatial aspect of this, I mapped each of the threats and displayed the results with graduated sizes.

The following graph provides a visualization of the frequency of reported threats. Not surprisingly, hurricanes and storm surges were talked about most, followed by saltwater and levees. The content of these three codes overlap significantly, although not entirely. Aside from the "Other" category that was only used to describe five threats, subdivisions were mentioned least.

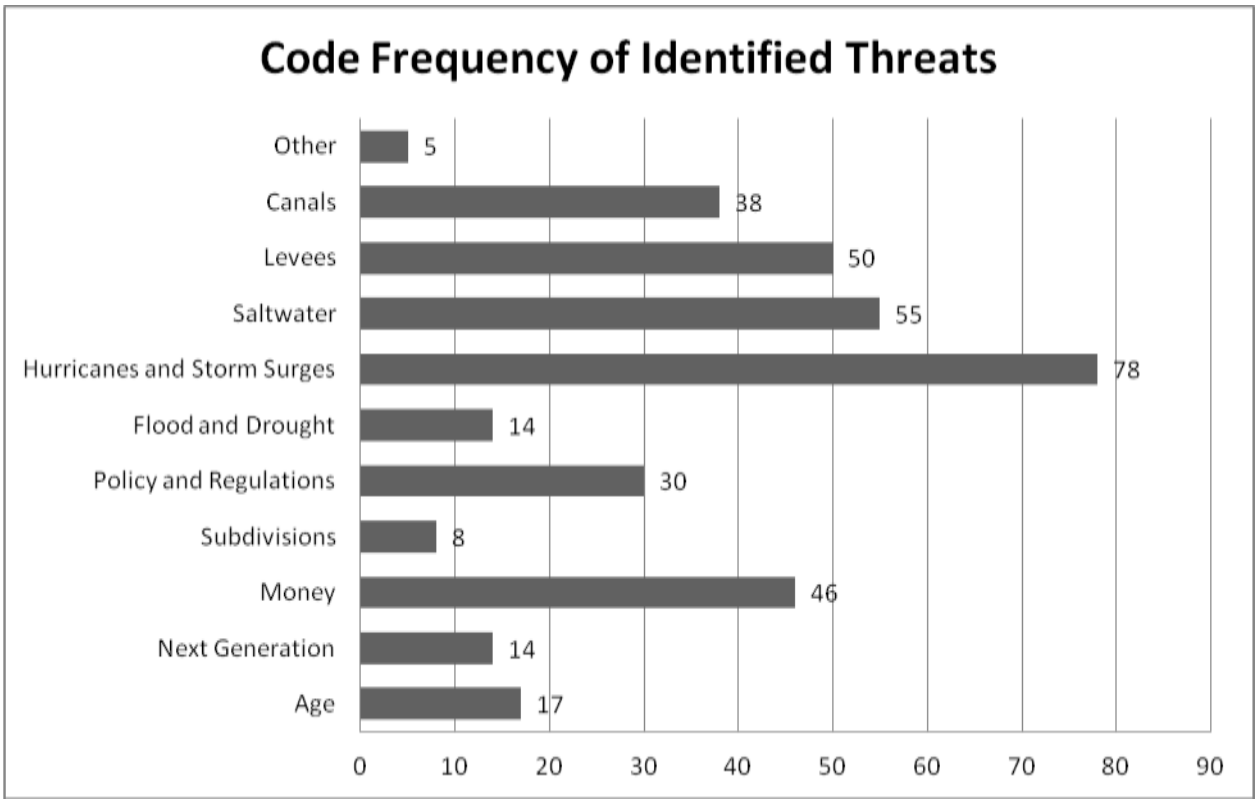

Figure 15: Code Frequency of Identified Threats

> Hurricanes, Saltwater, Levees, and Canals - the techno-environmental threats – were the top 4 most-mentioned threats. The least mentioned was subdivisions, which only came up in conversation seven times. Source: Danica Adams

Out of the eleven identified threats, subdivisions, next generation, and age were mentioned least, while, predictably, hurricanes, saltwater and levees were mentioned most. As shown in Figure 15 below, those cultural codes represent only 2% (Subdivisions), 4% (Next Generation), and 5% (Age), while the techno-environmental codes represent a much larger percentage of the total responses. Out of all of the times that threats were mentioned, hurricanes were talked about 22% of the time, saltwater was mentioned 16% of the time, and levees were discussed 14% of the time.

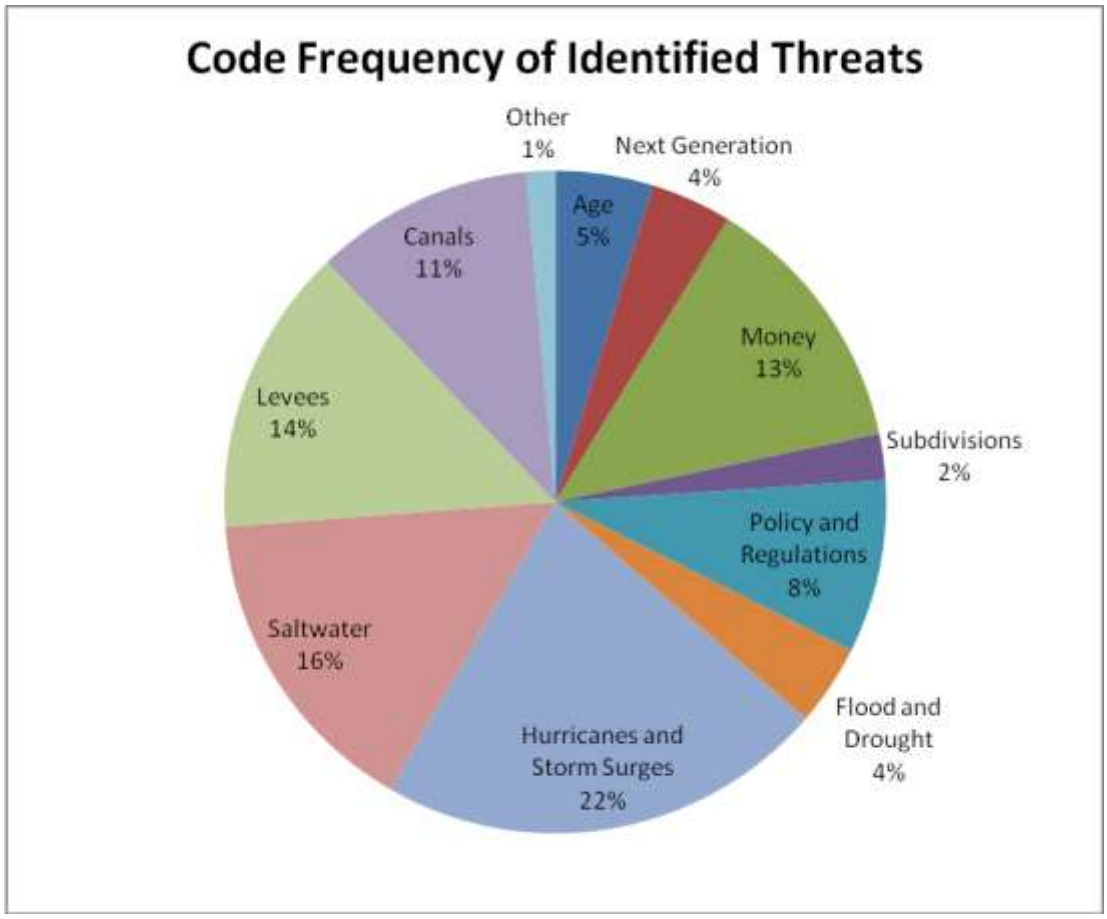

Figure 16: Code Frequency of Identified Threats

Breakdown of Codes as a Percentage of the Total Number of Responses. This figure shows the share that each perceived threat has of the overall number of responses. Subdivisions, while mentioned by a few people, made up the smallest share of the total number of threats. Source: Danica Adams

This chart shows that together, the top three most mentioned codes make up 52% of all of the total mentions of threats; the fourth largest category is canals, with 11%. As shown in the bar graph below, these four techno-environmental threats were mentioned 235 times out of 350 mentions of threats. The group of Cultural codes – age, next generation, subdivisions and money, was mentioned second, and the Regulatory code was mentioned least. This frequency according to code grouping, or meta-category, could be

attributed partially to the number of discreet codes included in each group. While the regulatory group has only one distinct code (policy and regulation), the cultural group has four (age, next generation, subdivisions, and money), the techno-environmental group encompasses a total of five codes (flood/drought, hurricanes, saltwater, levees, and canals). This difference in the number of codes within each meta-category can partially account for the large size of the techno-environmental code group.

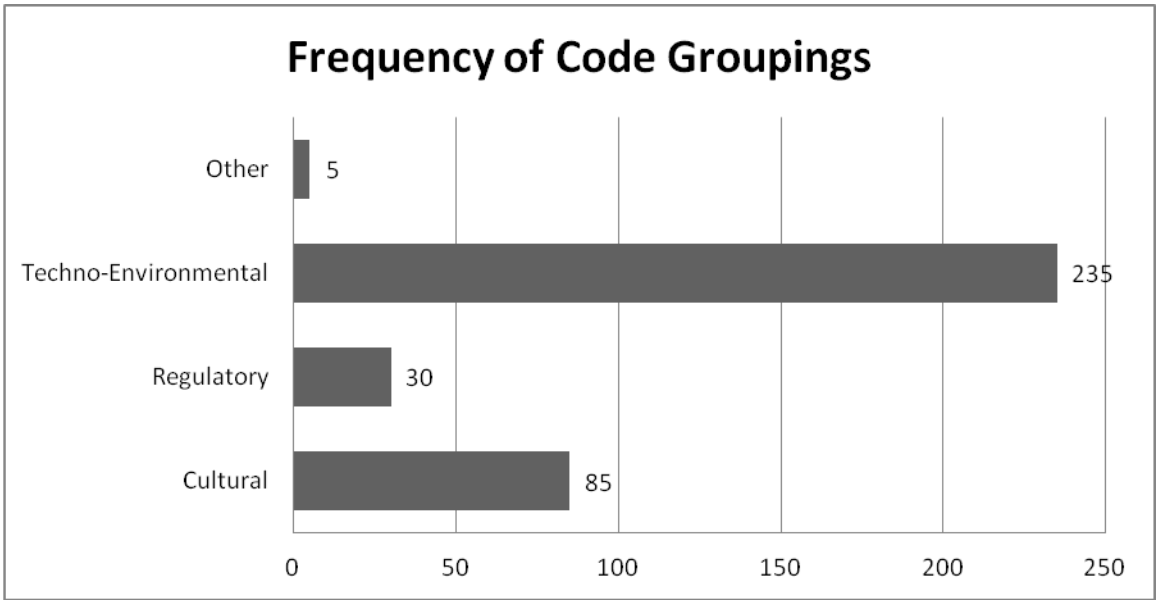

Figure 17: Frequency of Code Groupings

This illustrates the prevalence of the perception that techno-environmental threats are most significant to the cattle ranching industry. Source: Danica Adams

I hypothesized that several factors may influence an individual's perception of vulnerability. The first among them is whether or not the participant is, in fact, a cattle rancher. I also assume that differences in herd size, and consequently their level of financial dependence on that herd, would lead to differences in how ranchers experience risk, vulnerability, and threats. The third, and, I believe, most significant factor in

influencing a person's perception of adaptive capacity, is the location of their pastures in relation to the Gulf of Mexico, the marshes, and high ground. Accordingly, Table 3 below provides a breakdown of identified threats by the respondent's relationship to cattle ranching (whether they are or are not a rancher), the size of their operation, and the general location and proximity of their ranch to the Gulf of Mexico.

				Cultural				Reg.	Techno-Environmental					Other	
Participant #	Relationship to Cattle Ranching	Size	Location (North or South VP)	Age	Next Generation	Money	Subdivisions	Policy and Regulations	Flood and Drought	Hurricanes and Storm Surges	Saltwater	Levees	Canals	Other	Number of Threats Identified
1 HS	-	-	N			X		X		X	X	X	X		6
2 CS	Rancher	Lrg	M	X	X	X		X		X	X	X	X		8
3 CB	Rancher	Lrg	S		X	X				X	X	X		X	6
4 TC	-	-	N			X		X			X				3
5 KB	Rancher	Med	M		X	X	X	X	X	X	X	X		X	9
6 RS	Rancher	Med	N	X			X	X		X					4
7 AB	Rancher	Med	N	X	X			X	X	X					5
8 CL	Rancher	Med	M	X	X	X	X		X	X	X	X		X	9
9 JH	Rancher	Lrg	N		X	X				X	X	X	X		6
10 JL	Rancher	Med	M	X	X	X			X	X	X	X	X	X	9
11 TS	Rancher	Lrg	S		X	X		X	X	X	X	X	X		8
12 DH	Rancher	Lrg	M	X	X	X			X	X	X	X	X		8
13 JE	-	-	S					X	X	X	X	X	X	X	7
14 AD	-	-	N							X	X				2
15 PB	-	-	N	X		X	X	X		X		X			6
Code frequency:				17	14	46	8	30	14	78	55	50	38	5	
Number of respondents				7	9	11	4	9	7	14	12	11	7	5	

Table 3: Code Frequency of Identified Threats

Source: Danica Adams

The purpose of this table is to make explicit the relationship between these three variables. For each interview respondent, I showed whether they were a rancher or not,

and if so, the relative size of their herd. I classified a large herd as consisting of 200 heifers or more and a medium herd as one that is 50 head or more. I did not speak to any cattle ranchers with small herds. I also delineated the general location of the rancher – they would either be located in the northern (above Hwy 14), midsection (between Hwy 14 and Intracoastal Waterway), or the southern half of the Parish (below Intracoastal Waterway). Each respondent was marked with an "X" if they mentioned a threat at least once. At the bottom of the table is a summary of the frequency that each code was mentioned and the total number of respondents that mentioned the threat. On the far right side of the table is a summation of the total number of threats that each respondent mentioned. You can see that some respondents, such as Resp. 4, did not focus on threats during our conversation. My interview with this respondent was more informational, and tended to focus on how things work rather than what he perceived as threats. This is appropriate, to some extent, given that this respondent was not a cattle rancher. Other respondents were much more vocal about their perceptions of threats. In part, this could be due to the way that I steered the interview and the specific questions I asked. It is also due, in part, to the immediacy of these perceived threats. From the table above, I was able to make a few observations and discern some general patterns:

- Only cattle ranchers mentioned age, next generation, or subdivisions as threats. There were no non-cattle ranchers that identified these cultural threats. Only two non-cattle rancher identified money.
- All of the large cattle ranchers occurred in the southern part of the parish, but not all of the southern ranchers were large. Large means 200 heifers or more.
- Southern respondents all mentioned hurricanes, salt and levees.

- Canals were mentioned as a threat only by those respondents that I spoke with later in the interview process. As I came to a deeper understanding of the issues being discusses, I asked different questions.
- Saltwater and Hurricanes were the two topics that were mentioned by the most respondents
- Levees, canals, and saltwater were generally not identified as threats by those in northern part of parish. Saltwater was only identified as a threat by a northerner who had experience helping on long drives in the marshes

I assumed that geography, relationship to cattle ranching and the size of the herd would influence the respondents' perceptions of threats. While my observations do not contradict this hypothesis, they do not support it either. Although there were some relevant patterns identified – non-cattle ranchers did not identify cultural threats as readily as cattle ranchers, for example – those patterns were not explicitly tied to geography, relationship, or size.

To expand on the spatial analysis aspect of the table above, I mapped each of the threats according to the location of the respondents who identified them. The maps below were made by mapping the approximate location of each interview respondent and then symbolizing the respondent's identification of threats according to the number of times each respondent mentioned it. To do this, I made a shapefile in ArcGIS using small circles to show the location of each respondent. For those respondents from outside of the Parish, I located them at the northern edge of the parish, on Hwy 167, the main highway that leads to Lafayette, which is the closest urban area. I located the respondents that were from Vermilion Parish in the general vicinity of their primary location. Some respondents lived in one area, but operated primarily in another area. For example, on respondent lived in the northern part of the Parish, but performed his

everyday work in the far south of the Parish. In this case, I located him in the southern part, close to where he worked.

The first map, Figure 18, displays the Cultural threats: age, next generation, subdivision, and money. Each of these four codes is displayed with a different color, and the size of each symbol is related to its prominence during the interview. For example, one respondent did not identify any of the cultural threats, and so all of the symbols in that area are the smallest; conversely, another respondent discussed money nine times or more, and age between seven and nine times, but did not talk about subdivisions or the next generation. This respondent has two large circles to denote the concerns about money and age, and two very small circles to show that subdivisions and the next generation did not figure into his thinking.

Figures 18, 19, and 20 are similar maps, each showing a different group of threats. Figure 19 locates the Regulatory threats, while Figure 20 shows the Techno-Environmental threats. They are symbolized in a similar manner to the Cultural, as described above.

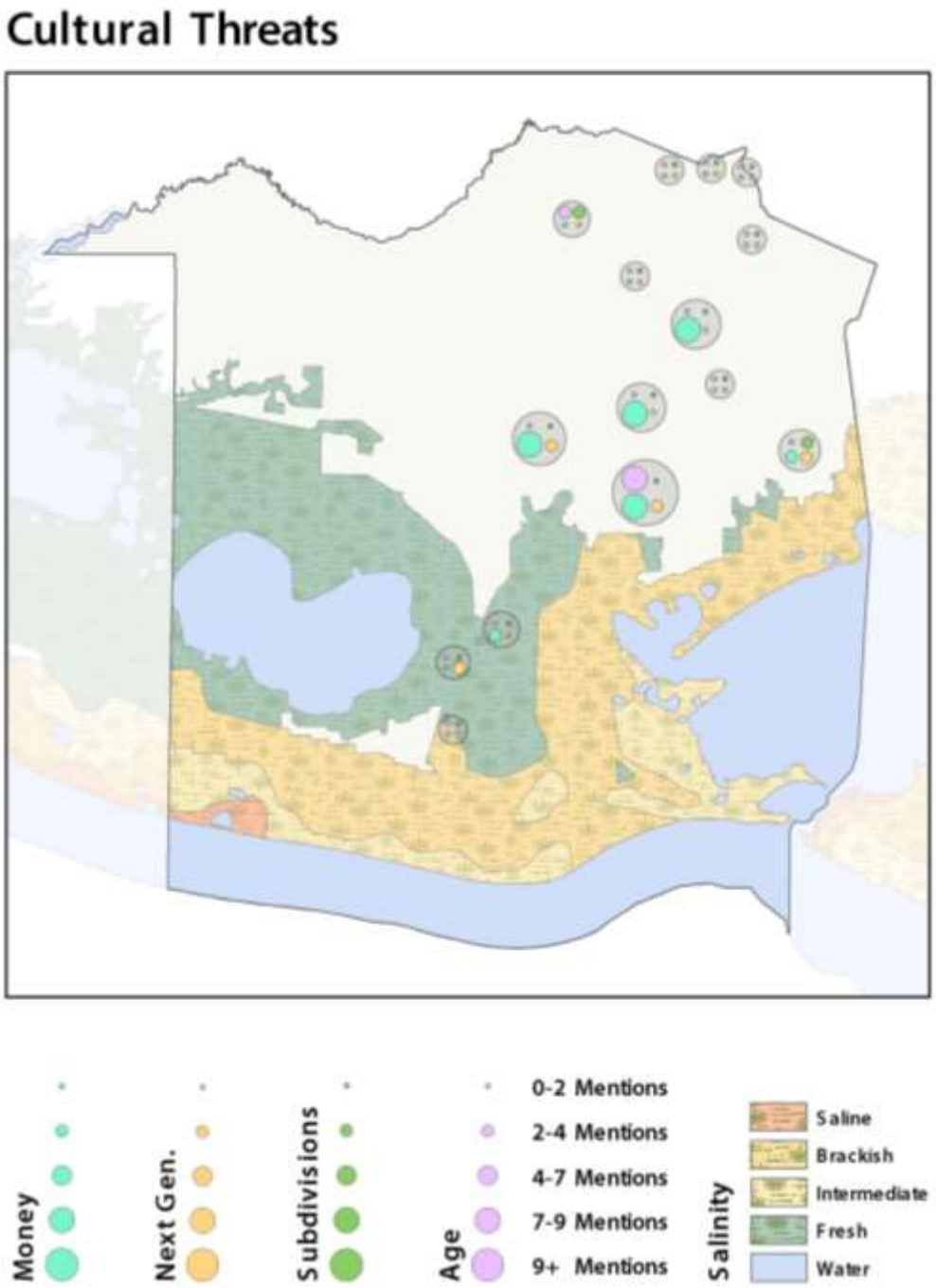

Figure 18: Map of Cultural Threats.

Source: Danica Adams

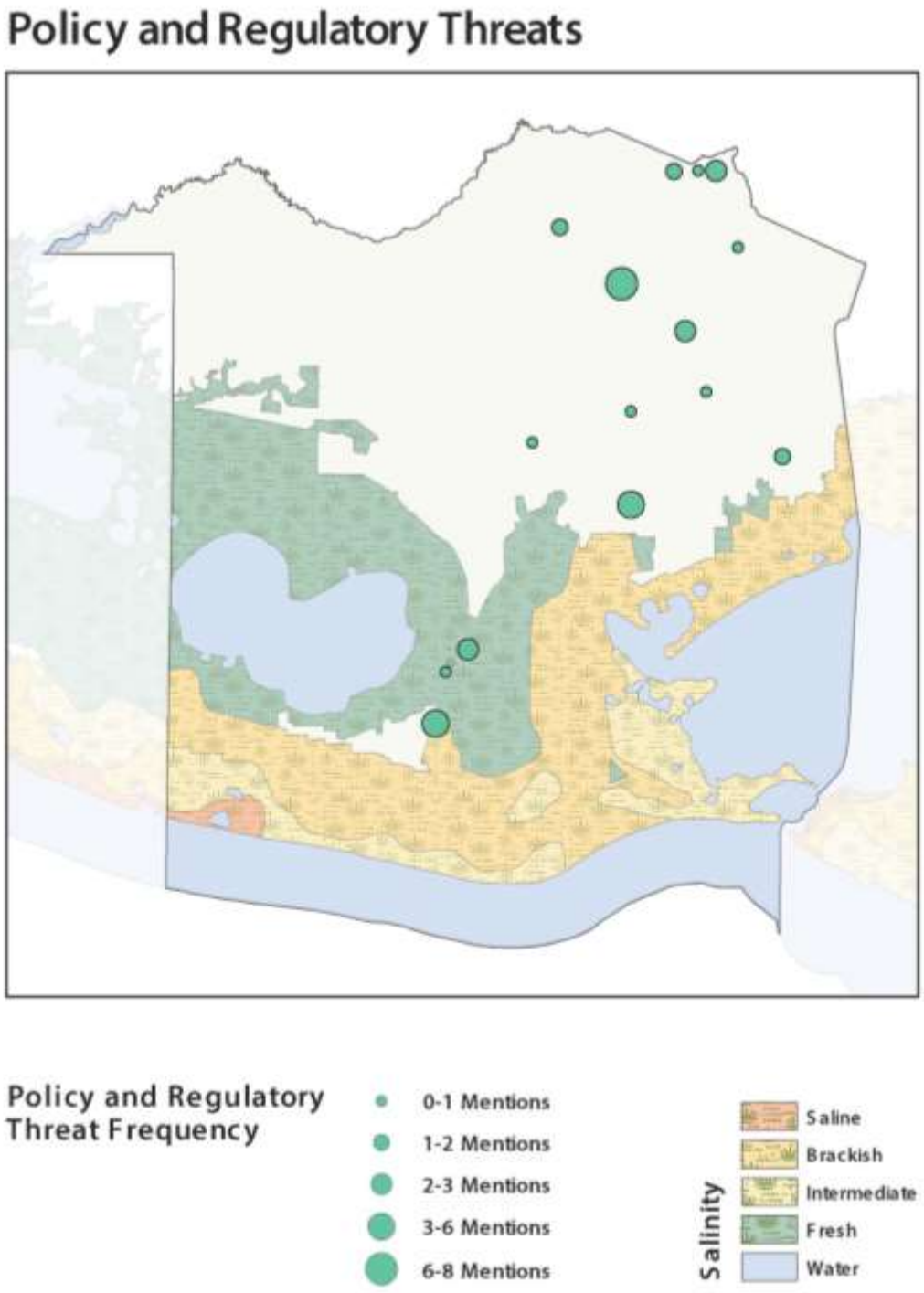

Figure 19: Map of Policy and Regulatory Threats

Source: Danica Adams

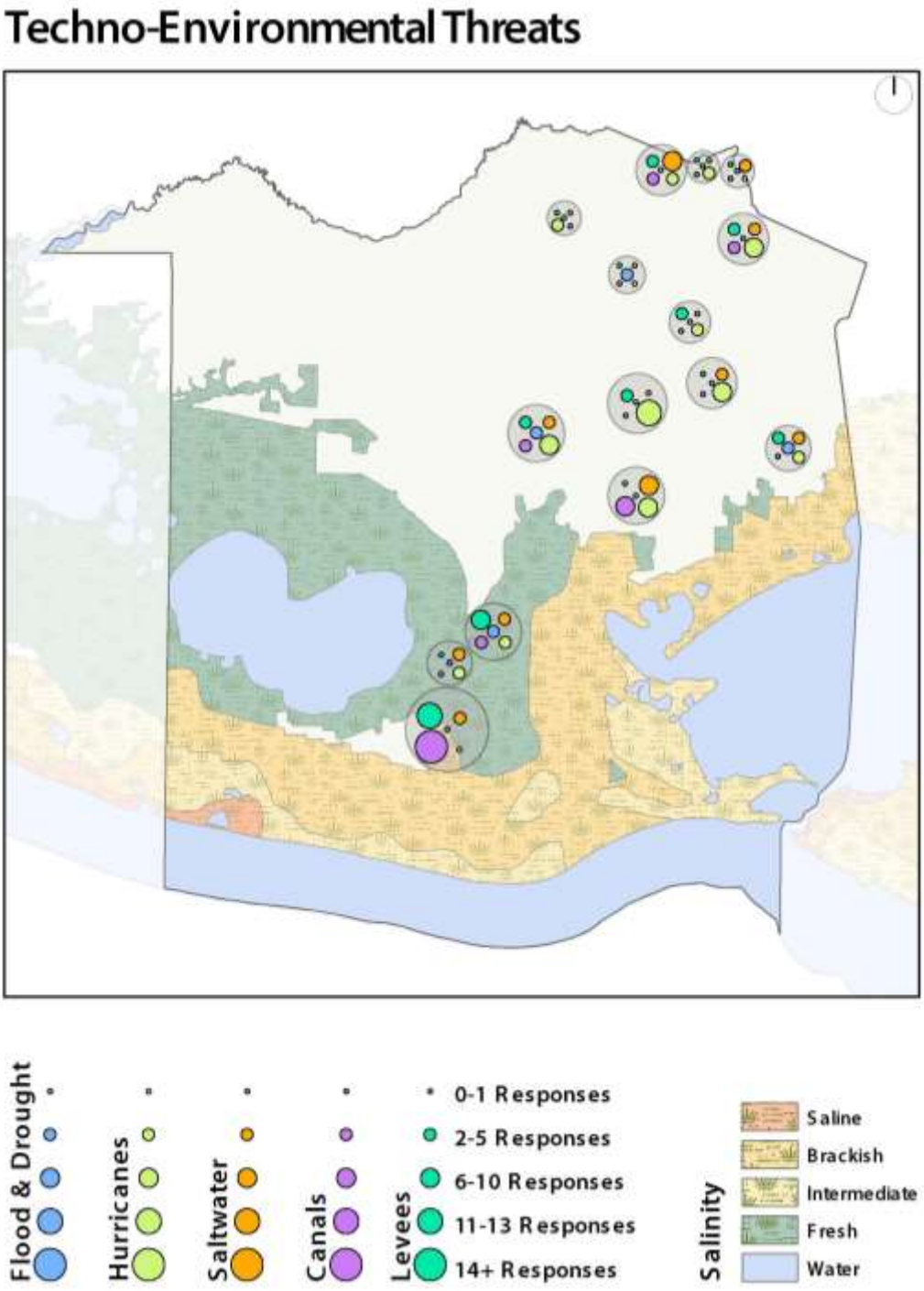

Figure 20: Map of Techno-Environmental Threats

Source: Danica Adams

The following map shows the relative importance of each of these groups of threats. As illustrated below, Techno-Environmental threats are a significant concern across geographies, while the Cultural and Regulatory groups are more sporadic.

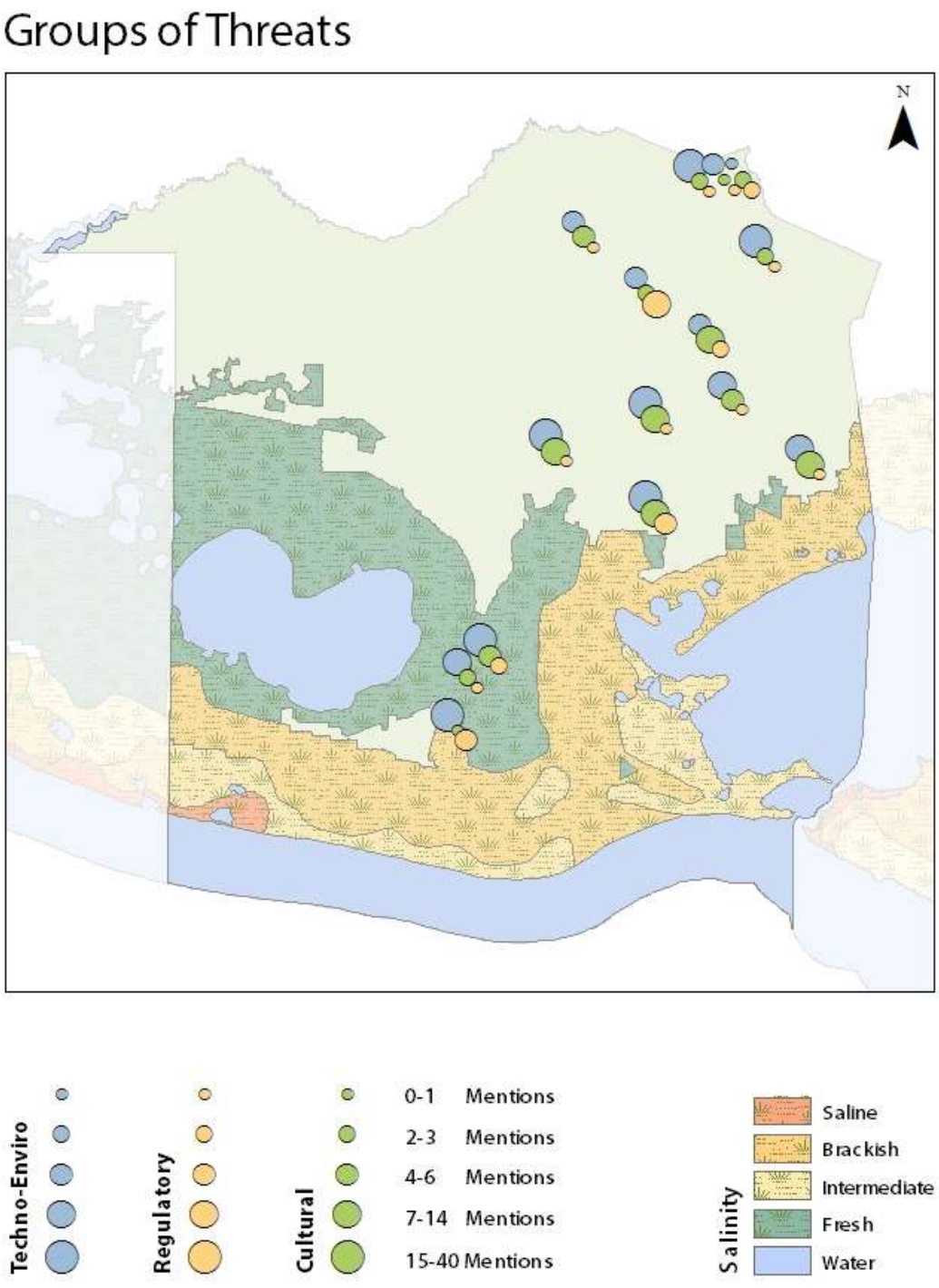

Figure 21: Map of Meta-Categories of Threats

Source: Danica Adams

My assumption was that geography – the consistent, direct interaction with the land – partially informs perceptions. The maps above do not contradict this idea, but they don't directly support it either. While most respondents, regardless of their location in the parish, identified saltwater as a threat, the southernmost respondent was most vocal about canals as a threat. The Regulatory threats were not geographically specific, although there were slightly more mentions of them in the middle to northern parts of the parish. Levees, canals, and saltwater were generally not identified as threats by those in northern part of parish. Saltwater was only identified as a threat by a northerner who had experience helping on long drives in the marshes. I anticipated a greater correlation between geography and perceptions. While this does support it to some degree, maybe with better indicators and a larger sample size, these would become more apparent.

The information from these interviews is complex and multifarious, but to gain a more intimate portrayal of each respondent, I employed the 3CM technique of cognitive mapping. These mapping sessions complimented the interviews by providing tools for participants to visually explore their perceptions of both vulnerabilities and adaptive capacities of the industry.

3CM

The goal of this type of data collection was to allow participants to give voice to complex knowledge structures and to get an in-depth explanation of participant's perceptions regarding spatial, economic, social, or environmental adaptive capacity of the industry within the parish. Typical card sorting techniques will present participants with a set of ideas, concepts, or pictures that the participants are then asked to sort and rank. The 3CM method differs from this by using a combination of interview questions and card sorting to allow the participants to identify, "own," and make connections between

pieces of information, or objects. It allows participants to explore and more succinctly discuss their own perceptions of the topic at hand. These included spatial, economic, social, environmental, and political perspectives, as well as a significant component of storytelling and explanations of traditions.

During the eight 3CM interviews, I wrote the major themes and concepts that emerged during the conversation on a blank note card. Participants were then asked to organize these concepts into categories and sort them in such a way that visibly shows how they understand the topic at hand. Because "the 3CM approach does not purport to distinguish truth from falsity or belief from fact," I was able to explicitly identify the perceptions of the respondents and gain a deeper understanding of the structure of their understanding of the intersection of cattle ranching, technologies, and the environment in Vermilion Parish.

While I was not able to do the 3CM exercise with every respondent, I was surprised and pleased with the results. Two respondents, both of whom are cattle ranchers, divided the identified nodes into "things you can control and things you can't."

Participant #	Relationship to Cattle Ranching	Size	Location	Ways of Describing Arrangement of Cards
2 CS	Rancher	Lrg	Location: Mid-Parish, between Hwy 14 and Intracoastal Waterway	Hurricanes are a significant factor. Hurricanes affect the older generation. Obstacles to getting (back) into cattle are: building up your herd & the price of cattle, fences (labor and cost), freshwater & saltwater. Canals: ...these canals were dug, but the canals are not what's keeping that cattle business from going back in there. The canals are what basically, I guess altered the hydrology to where you that's where you lost a lot of the marsh. This is a loss of marsh that the canals contributed to the loss of the marsh. Practices: burning the marsh grasses. He wants to create a new breed that is suited to the marshes.
8 CL	Rancher	Med	Location: Mid-Parish, between Hwy 14 and Intracoastal Waterway	Topics of Importance: Location: pump-off land (and the expense associated with it) vs. high land Rent vs Purchasing Land: when renting pasture, you have to compete with sugarcane and rise which pull in higher prices per acre, and so can rent for more. Pump-off land is cheaper per acre, but have expense of the pump and fuel. Things you've got to have: Quality Animal: a good cow can give you a $700 calf, or a little cow will give you a $350 calf. You might put less into a cheaper cow, but it will bring you less. Record System: Rancher would need to be able to keep a record system of what goes in to a heifer and what is coming out of that heifer. Management: of land and of herd Negative/things you can't control/facts of life as a rancher: Weather: hurricanes, salt, drought, tides Subdivisions and abandoned land: Fencing: electrical fencing is cheaper, but higher maintenance than wire

Participant #	Relationship to Cattle Ranching	Size	Location	Ways of Describing Arrangement of Cards
9 JH	Rancher	Lrg	Location: North of Hwy 14	You have to have your pastures to start with, then you have to have the right vegetation, and in order to have your vegetation you have to have your levees and your levees protect you from salt and water. You have to have your levees to protect yourself from the storms and weather conditions. Knowing your breeds is related to your storm conditions and your weather In order to get your right carcass quality, you have to have your vaccines and your medications. You have to have your machinery and your technology to be able to get your pasture conditioned and your vegetation growing because you have to pump off or you have to have your machinery to plant your grass if you have to plant some winter grass; your mowing. So you need to know your animals and your breeds, it's very important. But you have to have this set of particulars to be able to have your animals at all. If you don't have the pasture, if you don't have your locations, if you don't have your levees to protect your grass and all, you can't have your animals, then. So it's pretty hard to determine which is more important, because they are all related and they're all very important. Understand what I'm saying? If you don't have cost and profit then the whole rest of it doesn't matter.
10 JL	Rancher	Med	Location: Mid-Parish, between Hwy 14 and Intracoastal Waterway	Risk: Hurricanes, storm surges, levees, land loss Operations: You gotta pick your right breed, you got to vaccinate and worm otherwise death loss because we have very high worms and liver flukes. Money and Economics: Money and fences. When you rent property, pay by the head. As he picks up more property, he makes more money because I can put more cattle on it. Other is labor and other cost share tactics. When you rent land with a cash rent, you have to pay the fencing and all of that. Other cost share, you don't have to pay the fence, only per head. You can't go buy land and pay for it with agriculture. You have to inherit a bunch of land to make a profit.

Participant #	Relationship to Cattle Ranching	Size	Location	Ways of Describing Arrangement of Cards
11 TS	Rancher	Lrg	Location: South of Hwy 14	Okay, this right here cher, we can't control this, so it's bad. The things we can't control that are bad are flood, saltwater, storms, Hurricane Rita, and fresh water. The things we can control are pump-off & levees, cost & expense, breed of cow, and oil/gas offshore boats.
12 DH	Rancher	Lrg	Location: Mid-Parish, between Hwy 14 and Intracoastal Waterway	Things you can't control: coastal erosion, parasites/insects, price of oil (for pumping off land or to run equipment), equipment cost and maintenance, and tidal surge.
13 JE	Non-Rancher	N/A	Location: South of Intracoastal Waterway	Natural: storms, natural water flow Unnatural: canals, levees, [higher than normal] tides The tides didn't come [very far into the marshes] before the canals; the canals and levees go together. The levees weren't bad, you understand? The levees weren't bad. The only time the levees became a problem was when they failed and we weren't allowed to fix them. Okay? So they were doing their purpose. Sea level kind of goes all in here. Oil and gas is the reason for the canals. Natural water flow: Well no you have to understand the natural water flow, the natural hydrology to understand that all of this [canals, levees, high tides, lack of land management, poor government regulations] is unnatural. My belief is that with the natural hydrology if we didn't have canals and sea level rise, you wouldn't see the interior land loss. Government regulations discourage land management. Sea level rise is kind of like God's thing, it's the judgment I suppose.
15 PB	Non-Rancher	N/A	Location: North of Hwy 14	Pre-requisites to Economic Development of the Cattle Industry First and foremost, you have to have trust in the government. Without that, none of the rest is possible. Once you have trust, then you need affordable insurance south of Hwy 14 in order to tackle the rest. Regarding economic development in Vermilion Parish Education Workforce Development Coastal Restoration – necessary for businesses to move into Vermilion Parish Good Leadership Tourism

Table 4: Summary of Results of 3CM Sessions

Source: Danica Adams

Interpretation of 3CM Methods and Information

There were a few general mental models that emerged from the 3CM sessions. The four primary ways of addressing the topic were to: 1) Distinguish between the

natural and the unnatural; 2) Separate the things they can and cannot control; 3) Establish a chain of causation; and/or 4) Identify things that a rancher has got to have.

Another respondent stated that "this right here cher, we can't control this, so it's bad. The things we can't control that are bad are flood, saltwater, storms, Hurricane Rita, and fresh water" (Interview, February 2013). In this way, the respondent put himself in a position of reacting to those things with the things he can control: his levees and pump-off land, the cost of these, and his breed of cow. In general, the respondents did not consider many of the identified threats in the techno-environmental group to be within their control. It is possible that this explains why this category far outstrips the others in prominence – 67% of all of the coded threats were in this category.

Many of the respondents identified chains of causation. These chains often stemmed from things that were outside of their control, and subsequently included a series of actions or technologies designed to mitigate those things. For example, hurricanes and bad weather are outside of their control, but levee maintenance is something that they can affect. Another respondent explained that because of the southerly location of his pastures, which he considered outside of his control, "you have to have your machinery and your technology to be able to get your pasture conditioned and your vegetation growing because you have to pump off [the pasture]…" (Interview, February 2013).

Another identified chain of causation is "If you don't have the pasture, if you don't have your locations, if you don't have your levees to protect your grass, you can't have your animals… they are all related and they're all very important." This shows that the chain of causation is non-linear and often originates from the identification of a series of threats.

From the perspective of one respondent, the economic development that would provide a boost to the cattle ranching industry is predicated on trust in the government. He went on to say that once you have trust, then you need affordable insurance south of Hwy 14. Another respondent went on to say that profit is required in order to make the ranching system viable into the future. A third respondent stated that in order to raise cattle, you have to have a quality breed of animal, an efficient record system, and effective management of land and of herd.

This 3CM data allowed me to make suggestions that not only address the threats identified during the interviews, but also fit those recommendations into the frames of perspective that the respondents themselves. For instance, some of my recommendations will be aimed at increasing respondents perceptions of agency and control. While I agree that we cannot control the timing and magnitude of hurricanes, the ranchers can have more influence over the landscape. These Cheniers and marshes, the canals and levees in Vermilion Parish all determine the degree to which residents are affected by those hurricanes.

In the final chapter, Chapter 6, I synthesized the information from the archives, interviews and 3CM sessions and integrated it with resilience theory. From this synthesis, I made a series of suggestions and recommendations designed to increase the adaptive capacity of cattle ranching in Vermilion Parish. These recommendations explicitly address the traits associated with highly adaptive systems and make concrete implementation suggestions.

Chapter 6: Synthesis and Analysis

The "truth" about the conditions in which we find ourselves is constructed by individual actions. These actions are predicated on a belief about cause and effect, right and wrong. My job as an analyst is not to judge whether these perspectives are right or wrong, but to help people recognize that while they each know part of the story, there is always more to be known. The saltwater is a problem, especially in the southern most part of the parish. The levees do disrupt surface flow, causing problems such as erosion and subsidence. The canals were the first disruptions to the natural hydrology of the marshes. They introduced the need for land management techniques that, at the time, were geared towards protecting oil and gas interests and increasing available land for cattle ranching instead of mimicking the natural hydrologic patterns and processes. The challenge now is to align these perspectives and begin to move them towards action. In other words, the *critical* part of the *critical constructivist* needs to take the stage.

As discussed above, adaptability, or the adaptive capacity of a system, is the ability of the actors in the system to affect change. This could mean that stakeholders are able to alter both the system's proximity to a threshold and the shape of the stability landscape. Another way to define adaptive capacity is the actor's ability to determine the trajectory of the system state, or its position within the basin of attraction (Walker et al., 2004). For example, if the residents of southern Vermilion Parish were address the issues of canals and levees, they would effectively alter the features of the stability landscape – they would adjust the position of the thresholds and the height of the slopes. If the residents of the northern part of the parish were able to successfully attract the younger generation into ranching again, they would change the trajectory of the system within the larger landscape.

In order to increase the adaptive capacity of the STES of cattle ranching in Vermilion Parish, I looked towards resilience theory and the characteristics which systems with high adaptive capacity share. Highly adaptable ecological systems tend to have genetic diversity, biological diversity, and a heterogeneous landscape mosaic. Social systems that exhibit adaptive capacity are comprised of institutions and networks that learn and store knowledge and experience, create flexibility in problem solving, and are able to balance power among interest groups (resalliance.org, 2001). My goal is to develop a series of recommendations that are geared towards increasing the adaptive capacity of the system.

Systems with high adaptive capacity require tools to help navigate through periods of change and disruption. Folke et al. (2002) identify four factors that are required for dealing with natural resource dynamics during periods of change and reorganization: learning to live with change and uncertainty; nurturing diversity for resilience; combining different types of knowledge for learning; and creating opportunity for self-organization towards social-ecological sustainability (resalliance.org, 2001).

I developed a three pronged approach to integrate the traits of systems with high adaptive capacity and the 11 identified threats. These suggestions were geared towards increasing the adaptive capacity of cattle ranching in Vermilion Parish, and are illustrated below. These approaches are economic strength and diversification, opportunities for social learning, and multi-scalar collaboration.

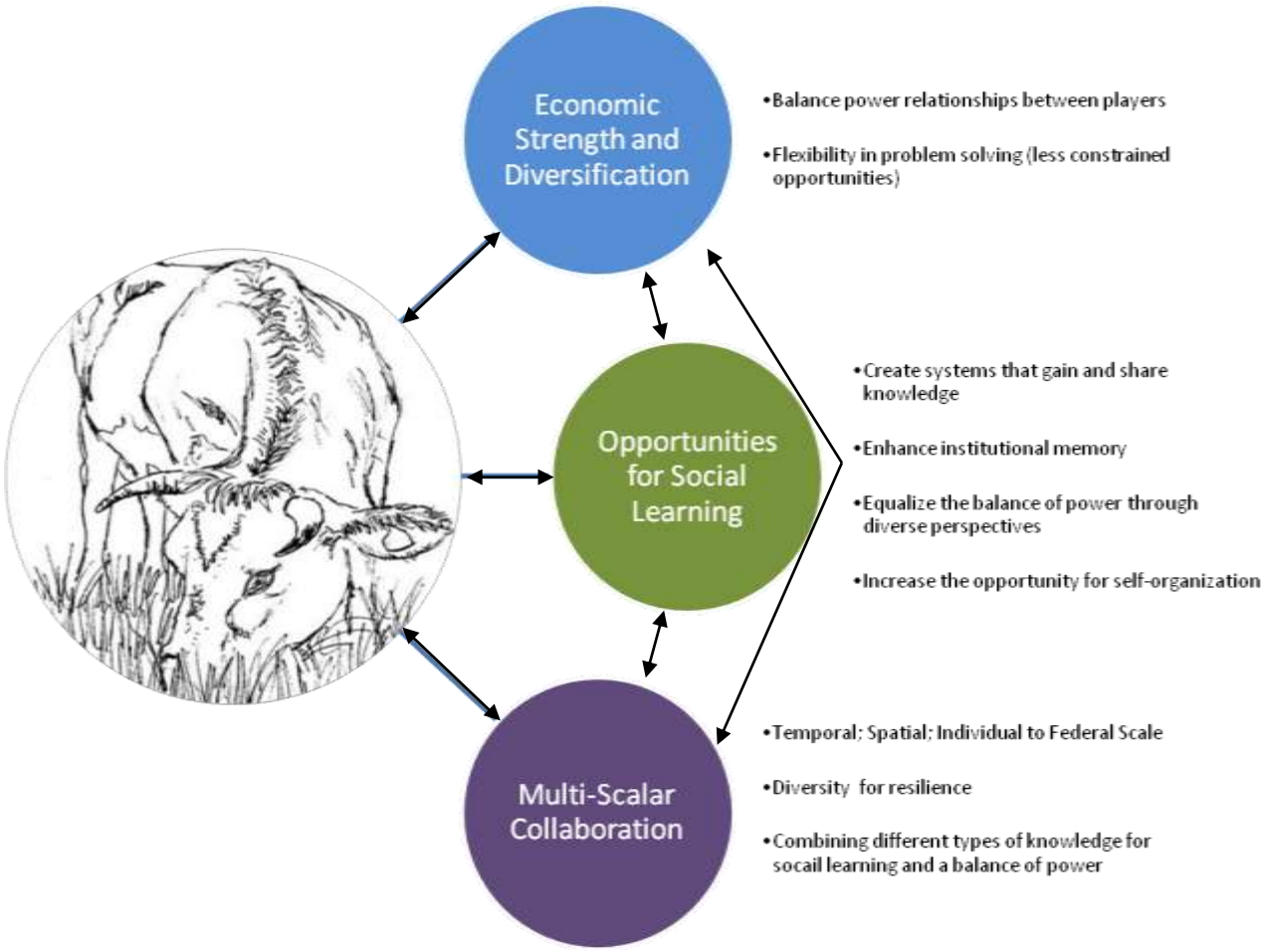

Illustration 1: Three Approaches to Increase Adaptive Capacity

Approaches to Increase the Adaptive Capacity of Cattle Ranching in Vermilion Parish. Listed next to each approach are the traits of adaptive capacity that they address. Source: Danica Adams

Based on the findings presented in Chapter 5, I argue that the system of cattle ranching is currently experiencing a decreased capacity to learn or store knowledge and experiences. This is, in part, because of the problems of age and generational heritage. Additionally, the actors' flexibility in problem solving is affected by their awareness of socially and economically viable options. Thirdly, the current power balance among

interest groups is skewed towards state organizations and the market. That is, in the sale of cattle, government regulations, in tandem with market forces, determine such variables as the price per pound. Financially, the ranchers themselves feel very little agency in manipulating the market to work for them.In the following sections, I will go into more detail in each of these three approaches and make specific, actionable suggestions that will be aimed at increasing the adaptive capacity of the system.

SUMMARY OF IDENTIFIED THREATS AND VULNERABILITIES

There were eleven types of threats and vulnerabilities that respondents identified over the course of my interviews. Some of those identified threats are things that, as individuals, we can only act on indirectly – for example, while individuals do not usually build or maintain levees, individuals can join together and have greater political influence over the state's decision to build or maintain levees.

Some of these problems are definitely ecological and social. As with canals and levees, they are also very much technological problems. Because we are facing social-techno-ecological problems, we need to conceive of social-techno-ecological solutions. These potential solutions will need to be small, and multiple. Collectively, we will need to widen our perspective and take in more information. The potential solutions must allow room and time for feedback loops – in other words, when a change is made, wait a moment to see what happens, and then reassess the direction of the recommendations before making another change. Although this can be time consuming and frustrating, grand plans with sweeping changes are likely to have more unanticipated results than anticipated, no matter the sophistication level of the environmental modeling techniques.

In the adaptive cycle, it is during the *alpha* (reorganization) phase, or more accurately, the transition between the *omega* (disturbance) and *alpha* phase, which

changes in a system are most likely to occur. It is during this reorganization of structure that novelty and mutations of the system have the opportunity to take hold, and a regime shift is most likely to occur (Walker et al. 2006). The time period directly after a disturbance is a fertile time to implement change. On the basis of these patterns, I will suggest that having a plan in place prior to a disturbance can allow people going through a destructive event to see the creative aspect of the destruction and know what to expect out of a rebuilding. It is important to start conversations about change well before it is time to implement those changes.

The following recommendations are based on all different types of data gathered and are conceived of as opportunities for the actors in the system of cattle ranching in Vermilion Parish to increase their own adaptive capacity. In others words, the ranchers themselves have the ability to move the system away from a threshold, as well as the ability to change the location of the threshold and the overall resilience of the system. Like some of the respondents, I first articulated the difference between things we can and cannot control: We cannot control hurricanes, but we can control how much they impact us and how we act in reaction to them. Storm surges and tidal action are outside the scope of our control, but we can control the depth, profile and linearity of canals, as well as how we manage our levees. As discussed in the previous chapter, the techno-environmental category of threats is larger than either the cultural or regulatory. The techno-environmental threats are technological, political and environmental in nature, but from the perspective of the individual, the solution lies in political strength and action through a civil society agency. The majority of the following recommendations, although they address the techno-environmental and the regulatory threats, are largely geared towards the cultural threats.

The identified problems are broad, but my recommendations were specific, and focused on those things that can be controlled. These recommendations were conceived of as being stronger when implemented together, but able to make positive change when implemented on their own.

ECONOMIC STRENGTH AND DIVERSIFICATION

Economic diversity can affect the power relationships between players and the system's flexibility in problem solving by providing less constrained opportunities and creating opportunities for self-organization. For example, if a rancher has the opportunity to hold calves over and finish them on grass in order to sell to local markets as well as the option to sell calves to a stocker, that rancher has flexibility in dealing with forage availability after a hurricane or flood. One of the difficulties associated with a grassfed beef operation, according to one respondent, is that there is no option to sell cows early if a pasture is negatively affected by flood or storm. An expansion of options, therefore, would be that if the pasture is flooded and the carrying capacity drops in half, the rancher may choose to sell half of his herd to the stockyard and carry half on the pasture to finish on grass. This would allow the rancher to avoid renting pasture elsewhere and the associated cost of transporting the cows. This turns the power dynamics more in favor of the individual ranchers and their ability to creatively problem solve rather than being dependent on the weather or the market to determine sale price, expense, or timing.

Illustration 2: Economic Strength and Diversification

Source: Danica Adams

Economic strength and diversity is affected by the variety of end goods that the rancher produces, the different markets that they cater to, and the way the rancher reaches the customer (Sayre, et al., 2012). A product is whatever the rancher sells. Currently the majority of ranchers have cow-calf operations. This means that they sell calves at the sale barn or through an order buyer. In this case, the product is a 500-600 lb calf. To diversify the product, the rancher may choose to sell exotic meats such as bison, sell carbon sequestration credits on their property, sell grass finished cows, or, as suggested by Sayre, et. al., the rancher could sell fire control by renting out cows or goats to eat grass and brush (2012). A market, in this sense, is comprised of a target audience and

caters to their buying preferences. Examples of diverse markets that the rancher could decide to make use of include the market for grassfed beef, the local food market, the market for humanely raised or wildlife certified beef (Sayre, et al., 2012). I am using the term marketing, on the other hand, to mean the methods of selling the product in a market. For example, when the product is a calf, it is sold in the conventional beef market, through conventional market forces. Development of alternative markets may allow sellers to retain more control over the process. Examples of alternative markets include producer cooperatives, direct sales through farmers markets or CSA's, producer-marketing boards, or companies that contract from multiple producers (Sayre, et al., 2012).

The following recommendations and suggestions are aimed at expanding and diversifying the markets available to producers, the products that they sell, and the marketing options that they employ.

Recommendation 1: Develop Profitable Cattle Market

A more economically profitable cattle market could help address the younger generation's lack of interest, and, the other side of that, the problem of the aging demographic. If ranching were more profitable, it would be more enticing for the younger generation to get involved. In a round-about way, profitability in cattle ranching could reduce the instance of subdivisions and urban encroachment into pastures by reducing (although not eliminating) the gap between profitability of ranching and of subdividing. I drew from the ideas above to develop the following suggestions on how to increase the economic strength of cattle ranchers.

Suggestion 1.1: Encourage Grass Finished Beef

The LSU Agricultural Extension Office, the 4-H club, and the Vermilion Parish Cattlemen's Association (VPCA) can work together to increase available information and support regarding the transition to grass finished beef. By encouraging grass finished beef that can be sold regional grocery stores, the rancher can claim a larger share of the overall transaction. The beef must be sold cheap enough for Vermilion Parish residents to purchase easily but priced to make more of a profit than the traditional calf purchase price at the sale barn.

One aspect of this is high quality, year-round forage availability. According to one interview respondent, an expert in south Louisiana forage crops, a successful grass finishing program would necessarily include a Rye grass mixture. By working within the existing structure of field days and field trips set up by the VPCA, cattlemen can work together to more fully explore the idea of grass finishing and how to achieve it on their farm. In this way, this suggestion ties in with my recommendation for increasing social learning opportunities. Several of these suggestions also represent employment opportunities in the cattle industry, adding an additional element of economic development.

Suggestion 1.2: Mobile Processing Unit

Sayre, et. al. state that in many parts of the country, the largest barrier to diversified marketing, especially for small to midsized ranches, is the lack of accessible USDA certified processing facilities. Additionally, many commercial slaughtering facilities will not process small batches of locally finished cattle, or cattle that are smaller in size than standard cattle. This can preclude ranchers from selling directly to local customers, or from diversifying the genetics of their herds (Sayre, et al., 2012).

In response to this, I suggest a mobile processing unit (MPU). A mobile processing unit is generally more cost effective to build than a stationary facility, and by traveling from farm to farm, they allow on-farm slaughter, which many people consider more humane than trucking animals to a slaughter facility. Based on a cursory internet search, one MPU can accommodate 10 beef, 24 hogs, or 40 sheep per day with two butchers, and the Units come complete with all installed equipment required for operation under USDA Inspection. Current base price for the 36ft unit is $205,000 (Dunlop, n.d.; Overview of Mobile Slaughter Units, n.d.). The MPU is used for processing, but the meat must still be brought to a local cut and wrap facility to be sold or distributed.

One interview respondent told me that a local organization, Acadiana RC&D, was going to pursue the purchase of a MPU, but ultimately did not receive a grant for its purchase. I will recommend that either this organization or the VPCA reopen the possibility of purchasing one of these. Without an MPU, *Suggestion 1.1: Grass finished beef* is not possible. An added benefit of an MPU is the opportunity for employment of several people in the cattle industry.

Suggestion 1.3: Form a Grass Finished Cooperative

Vermilion Parish has until recently been the largest beef parish in the state, but few people outside of Vermilion and Cameron Parish (to the west) realize that southwest Louisiana is a significant beef producing region. Louisiana is known for other food crops – seafood, crawfish, rice, sugarcane and sausage – but not as much for beef. A grass finished cooperative – an organization or business that is owned and managed by a civil society group, in this case the ranchers of Vermilion Parish – would allow ranchers to leverage their numbers and work together to promote their unique product under a common brand and/or label. The cooperative would have greater marketing, advertising

and distribution power than an individual rancher alone, and would provide another job opportunity related to raising cattle. A Vermilion Parish beef cooperative would also fit well with the nationwide food trend towards all things "local."

In conjunction with the above suggestions of encouraging grass finished beef and purchasing a MPU, and under the auspices of the grass finished cooperative, I recommend the development of a local "brand" that would be available for any member of the grass finished cooperative to put their own label on. This is similar to the "Buy Fresh Buy Local" campaign which "certifies" an independent product. It is one example of the behavioral approach to sustainability as described by Brand (2005). A behavioral approach to addressing sustainability

An alternative to a cooperative-type structure might be an independent company that contracts with multiple producers to supply beef for a single brand. An existing example of this is Horizon Organic Dairy that purchases milk from small and large family farms and sells it under a single brand. This alternative allows a large distribution scale while supporting multiple small producers. This would have to be a project done by an individual rather than a group of farmers.

My suggestion for a brand or logo would incorporate the traditional "brand" look and a reference to Vermilion Parish as a unique place as well as the use of the word "Vermilion" to mean "red." Some suggestions include:

- Parish Beef: All Grass, All Vermilion
- Vermilion Rouge
- Green Grass, Vermilion Beef

Suggestion 1.4: Develop Local Markets

The development of local markets by building relationships with grocery stores in Vermilion Parish as well as nearby urban areas such as Lafayette, Baton Rouge, or New Orleans can help reinforce the regional cultural importance of cattle as well as develop a loyal customer base. Robies in Abbeville, Rouses and Fresh Market in Lafayette, Baton Rouge and New Orleans, Adriens and Champagnes in Lafayette, are all local grocery stores that make an effort to carry Louisiana-made products. Even Whole Foods in Baton Rouge and New Orleans (and soon to be located in Lafayette) makes an effort to carry local produce, meats and products.

Another local market could be the Vermilion Parish school system. The school system would provide the profit margin that a Whole Foods might be able to provide, but the need would be consistent and the public relationship could be widely advertised.

Suggestion 1.5: Equipment Collective

Beyond the products, markets, and marketing that the ranchers of Vermilion Parish may be able to influence or manipulate, another aspect of economic diversification has to do with the expenses associated with raising cattle or getting into the business. The primary expenses differ according to the location of the ranch, but in general they include cost of land, cost of heifers or bulls, and the cost of equipment or diesel to operate the equipment. Equipment costs include tractors, trailers, fences, pumps to pump water off a pasture, diesel to run the pumps, diesel to run the tractors, and chutes, scales, and tables – all things that are needed to work cows. The VPCA currently has some equipment that can be rented by farmers at a very low rate. This collectively owned equipment is intended to support smaller ranchers and lower the barriers to entry, but it is reputedly in ill repair. My suggestion is to fix or replace what they have, as well as broaden the equipment that they keep and are able to rent out.

New or small ranchers who may not have the upfront resources to purchase this equipment or family to borrow it from would benefit. This will tie into a later suggestion that encourages a young farmer incubator program.

Part of the difficulty associated with this suggestion is the cost of purchase, cost of maintenance, and storage. I suggest that the VPCA partner with the Acadiana RC&D for cost of purchasing and maintaining equipment and assistance with storage.

OPPORTUNITIES FOR SOCIAL LEARNING

The process of obtaining, interpreting, and acting upon information is both an individual and a social experience. Holden states that:

> Individuals and communities have diverse, partial, and sometimes irreconcilable perspectives on public problems and solutions. Learning together where these partial views intersect, diverge, and may reach compromise may be the only democratically legitimate means of devising socially reliable solutions to many contemporary planning and policy problems. (Holden, 2008)

Along these lines, opportunities for social learning can help create systems that gain knowledge, can enhance the institutional memory of the system, equalize the balance of power through diverse perspectives, and increase the opportunity for self-organization. I intend the term *social learning* to mean a system-wide change in understanding that occurs as a result of both individual and group social interactions such as conversations or shared experiences (McCarthy et al., 2011). I will conceptualize learning in terms of changes to individual or system-wide agency – an adaptive behavior (Pelling et al., 2008). An increase in your agency, for example, would be an increase in how much you can decide about your life. Social learning can take many forms. It may be found in conversations between ranchers about how to market their product, in discussions on the Parish level about economic development opportunities, or it may occur during a larger conversation at a 4-H club meeting about reasons to host a rodeo.

McCarthy, et. al. cite Keen, et. al. (2005) when they say that "social learning is a process of iterative reflection that occurs when we share our experiences, ideas and environments with others" (McCarthy et al., 2011). This focus on reflection of shared experiences or ideas can be seen in Vermilion Parish during conversations and subsequent actions in regards to hurricanes and how to prepare for them.

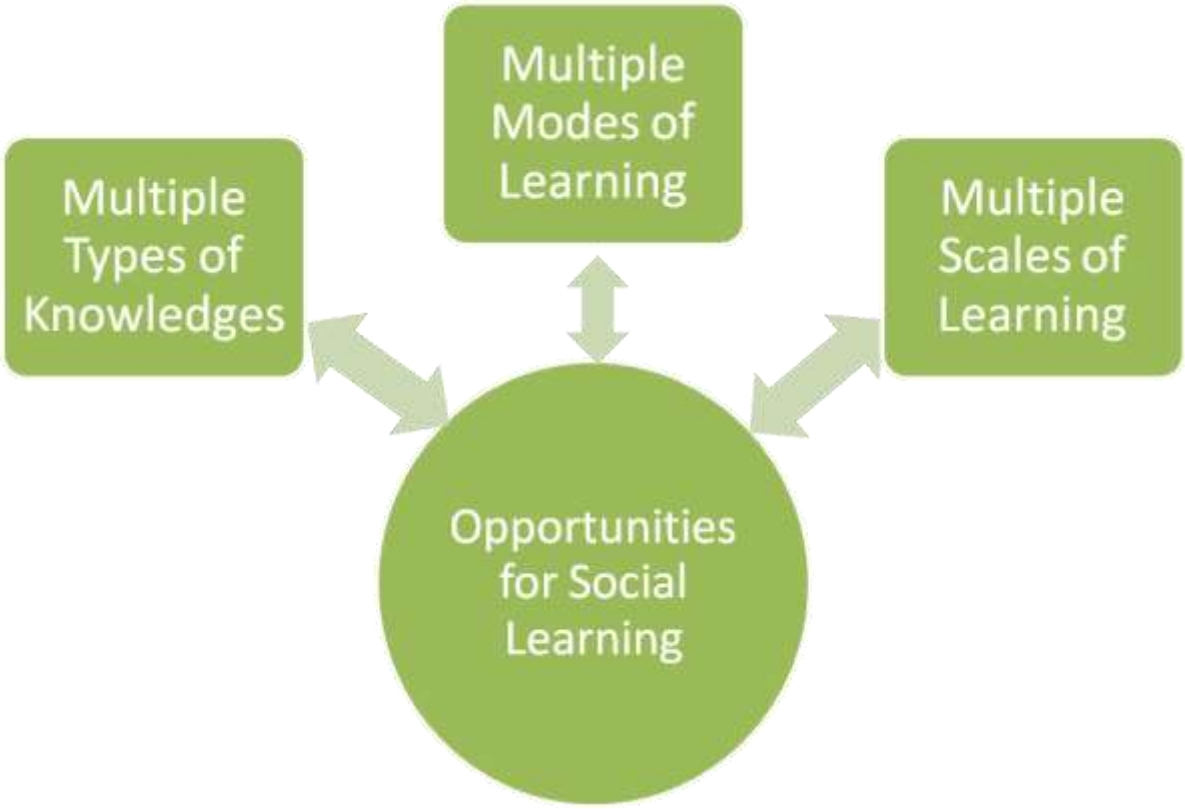

Illustration 3: Opportunities for Social Learning

Source: Danica Adams

Many conversations occur between like-minded individuals or within somewhat homogeneous groups. For example, it is not unusual for academics to talk largely among themselves, ranchers to discuss events with other ranchers, or politicians to only consider the political angle of a situation. When multiple types of knowledge – local,

scientific, and political, to name a few – are all included in a conversation, the social learning opportunity is enhanced. Multiple modes of learning can also be incorporated into opportunities. Modes of learning can include shared conversations, collective experiences, or written literature.

Multiple scales of learning, as illustrated in Illustration 3 above, can also contribute to effective social learning opportunities. Learning, or adaptive behavior, that manifests itself at the individual scale could be the result of interactions or learning that has occurred at a larger scale – say, that of an organization or a Parish. The reverse – that organizational learning could result from individual learning - could also be true (Pelling et al., 2008). The VPCA, for instance, may, over time, move towards a grass-oriented approach to ranching. As this happens, it may bring along individuals who would not have typically considered a grass finished program. Alternately, if several individuals routinely attend and participate in meetings about coastal restoration, through these continued interactions, the individuals and CPRA (Coastal Protection and Restoration Authority) may come to appreciate the issues from a new, combined perspective. The following recommendations and suggestions for increasing social learning opportunities incorporate many of these ideas.

Recommendation 2: Communication

Kearney and Kaplan, in their work Toward a Methodology for the Measurement of Knowledge Structures of Ordinary People (1997), discusses the idea that people tend to ignore or sequester information that does not fit into their existing conceptual map. This means that even if new information about the hydrologic impacts of levees is given to residents of Vermilion Parish, depending on the current conceptual map of the resident, that information may be ignored or it may be processed and then "set aside"

(Kearney and Kaplan, 1997). For this reason, in order for scientific information about coastal process to be incorporated into a person's actions, for instance, efforts must be made to incorporate that information into the person's cognitive map. In other words, information must be framed in a way that encourages people to notice and integrate the new information rather than ignore or reinterpret it (Kearney and Kaplan, 1997). Ultimately, it is people's perceptions of why things happen the way they happen will determine what type of change they are open to.

Current cognitive maps can help explain how new information is understood and whether or not that information will impact behavior (Kearney and Kaplan, 1997). Based on this premise, I strongly suggest increased communication between cattlemen, research organizations such as NOAA (National Oceanic and Atmospheric Administration) or USGS (United States Geological Society), social organizations such as the Vermilion Parish Cattlemen's Association, and state coastal restoration organizations such as CRCL (Coalition to Restore Coastal Louisiana) or CPRA (Coastal Protection and Restoration Authority). Within small groups of stakeholders, the actual exercise of doing 3CM sessions can explain how and why people conceptualize problems and can bring new ways of thinking to light for the rest of the group. 3CM sessions themselves can facilitate and promote more open communication between divergent parties. However, since Vermilion Parish is a large area and the stakeholders include parties from outside of the area, as in the case of state legislators, it is not feasible to recommend a series of 3CM sessions. Instead, I will outline below other ways to increase communication.

Suggestion 2.1: Get Involved in Current efforts

There are several organizations that provide opportunities for listening and speaking up. For instance, the Vermilion Parish Resiliency Planning effort, scheduled for

completion at the end of 2013, has been engaging Vermilion Parish stakeholders in a series of meetings.

Another example is CRCL (Coalition to Restore Coastal Louisiana), who is hosting as series of "Community Conversations about Coastal Restoration," designed to encourage communication between lawmakers, state agencies and local stakeholders. I attended one of these meetings on February 28th in the Vermilion Parish Courthouse in Abbeville. The agenda for the Abbeville meeting included representatives from the offices of U.S. Senators Mary Landrieu and David Vitter, a representative from Congressman Charles Boustany's office, State Representative Bob Hensgens, several representatives from the Coastal Protection and Restoration Authority of Louisiana and others (www.crcl.org/blog-menu-item, n.d.). While I believe that this signals increased attention as to the importance of communication, I also believe that it fell somewhat short of its goal. This brings me to the next suggestion.

Suggestion 2.2: Improve Current Efforts

I will take an initiative that is already in place – CRCL's Community Conversations about Coastal Restoration - and suggest a few slight modifications designed to improve open dialogue.

Ideally, these meetings would be attended by a large and diverse audience, and there would be multi-directional conversations to allow multiple perspectives to be aired. In this case, however, the meeting was attended by a few of the usual suspects, and while they were well informed and some of them asked questions and made comments, dialogue seemed to be lacking.

In this case, the Police Jury, the Parish governing unit, could be a good organization for outreach and engagement with the wider community. The Police Jury

could benefit from increased attendance and participation at these meetings and the increased attention from Baton Rouge directed towards Vermilion Parish.

A simple method of making people feel more comfortable participating in a conversation is to set up seating in a circular arrangement instead of putting the officials in the front of the room with a powerpoint presentation and having the attendees sit, facing them.

Suggestion 2.3: Knowledge Sharing

Public learning and dialogue takes place when topics are regularly broached in the public realm. The challenge here will be to facilitate dialogue surrounding local knowledge, new knowledge and scientifically accurate information about everything from nutritional content of forge crops to marketing techniques or current information about restoration projects.

I learned that most of the cattle ranchers are 60+ years old and at least a few of them are internet and technology-averse. So, although developing a website is currently a popular solution to sharing information and providing an easy forum for discussion, this demographic may more easily access and consider information from a regular radio show or newspaper column. This suggestion is one that would take more effort to implement than the others, but I propose that an individual or an organization tackle the effort of developing a weekly call-in radio show or a weekly column in *The Meridional*. While the former is more interactive and therefore more of a public dialogue, it also requires more expertise to develop. If the 4-H club was able to be involved in the research or the execution of either of these, it could help bridge the generation gap and encourage the younger generation to take part.

Recommendation 3: Reinforce Cultural Connection to Cattle

Culturally derived threats, because they encompass human behavior and values, are complicated to address. Reinforcing the importance and prominence of cattle in the culture of southwest Louisiana could be an important step in addressing the cultural threats of the *Next Generation*, *Age*, and *Money*.

There are already organizations and events that have sprung up around the cattle culture that, in practice, reinforce its prominence. The Louisiana Cattle Festival, an annual celebration of cattle ranching in Vermilion Parish is held in downtown Abbeville, the Parish seat. The 2013 event, held during the second weekend in October with events such as beauty pageants, a Trail Ride, and a barn dance in the weeks leading up to it. The celebration in 2013 will be the 65th annual Festival (louisianacattlefestival.org, n.d.). Additionally, the Vermilion Parish Cattlemen's Association (VPCA), a local chapter of the state and national organization, is the largest Cattlemen's Association in Louisiana (Interview, Feb. 2013). It is comprised of ranchers and supporters alike, all of whom are listed in the VPCA Directory. The Directory is a relatively new feature of the Association and serves as social as well as work-related list of people associated with cows. The VPCA holds several annual social activities and banquets, all reinforcing the importance and relevance, as well as the fun-loving attitude, of cattlemen. The 4-H club is a youth branch of the LSU Agricultural Extension Center and gets kids involved in many "Learning By Doing," including raising livestock (4H Vermilion Carcklins, www.lsuagcener.com, n.d.). The 4-H club publishes a monthly newsletter called *Cracklins*. The Vermilion Parish 4-H hosts a Junior Livestock show each year in addition to sponsoring a beef poster contest and a beef cookery contest. The following suggestions use the existing organizations and builds on their role in the community.

Suggestion 3.1: 4-H start a mentor/mentee opportunity

While I separated *Age* and *Next Generation* into two distinct classes, one possible way to address the threat of age is to include the next generation in the practice of cattle farming. I suggest systematically incorporating and training kids and young adults in all aspects of cattle farming, thereby lowering the barriers to entry. Right now the only effective way to get into the cattle ranching business is if you were brought up in a cattle family. If you are not raised in a cattle family, however, you would have limited exposure and opportunity to enter the field. This is made worse by the reduction in cattle families and the generational gap that exists.

I met at least one cattle rancher who does not have kids and many ranchers whose kids are not interested in the practice of ranching. Each of the respondents that I spoke with was interested in passing down knowledge and sharing their experiences with a younger generation. Since the 4-H club is already encouraging kids who are interested in livestock, I suggest that they expand this to include partnering kids who are interested in cow but are not from cattle families with nearby adults who would be willing to mentor them. Mentors can be suggested by members of the VPCA.

Suggestion 3.2: Incubator

The 4-H club encourages kids to get involved with raising cattle and the VPCA provides social and technical support for adults that are already in the cattle farming business, but there is not currently support for the transition from interest to practice. The jump from taking care of one or two cows while in high school to building and managing a herd is large – especially if your family does not have equipment or land.

ATTRA, Appropriate Technology Transfer for Rural Areas, outlines a variety of mentoring opportunities and resources for new farmers, young farmers, women farmers, and established farmers. There are several examples of farm or ranch incubator

programs, where an organization leases land and facilities to small organic enterprises and provides technical support with other more experienced farmers. Some programs also offer a wash/pack facility and shared-use equipment for new farmers to use to incubate their farm businesses.

In Vermilion Parish this incubator model may work with the LSU AG Center, the VPCA, and/or the Vermilion Corporation. To help with the start-up costs, an incubator program may incorporate an opportunity for interest-free micro-loans for small ranchers to buy new bulls of heifers. One possibility to address both the skill gap and financial hurdle would be a work exchange program. In this scenario, high school kids would work with a rancher over the summer in exchange for calf.

Suggestion 3.3: Rodeo in Vermilion Parish

The Mid-Winter Fair and Rodeo in Lafayette is currently held annually in mid-January. This could provide another opportunity to engage the youth of Vermilion Parish. I suggest that the 4H Club and the LSU Ag Extension Center to join forces and organize a series of youth-oriented preliminary contests. These could promote the horsemanship required for raising cattle through barrel racing and roping, for example. It could also encourage the direct skills needed to manage a herd. These would be skills such as raising a quality animal that would be an efficient grazer.

The following approach to increasing the adaptive capacity of the system is one that addresses the multiple techno-environmental threats through multi-scalar collaboration and interaction. While these techno-environmental threats make up the bulk of the mentioned threats, they are also the most difficult to address. As I have mentioned previously, while the threats and vulnerabilities may be technological or

environmental in nature, the solutions are rarely either technological or environmental. Instead, as I discuss below, the actors may need to turn to civic or political solutions.

MULTI-SCALAR COLLABORATION AND INTERACTION

Multi-scalar collaboration is the relationship of individuals or organizations operating at different scales. The different scales are temporal, spatial and organizational. Collaboration could occur between all three of these scales or within each scale.

Collaboration could be on a temporal scale by collaborating over long and short time periods. In the language of resiliency theory, this would mean allowing fast cycles and slow cycles to influence each other. In other words, when deciding on short term projects, long term repercussions are taken into account, and when making decisions about long term goals, the immediate consequences of those decisions are considered. The interaction between the longer cycles of the federal government and the shorter cycles of the calving seasons is one example. Multiple calving seasons can fit into the time it takes for the federal government to decide and act on anything to do with the marketing and direct sale of beef. Nonetheless, the federal government should look to these seasonal cycles of ranching activity to inform their policy and timeline, while the ranchers take a longer view and continue to build political strength and advocate for change.

Multi-scalar collaboration can also occur on a spatial scale, or over both long and short distances. One example of this would be designing a Mississippi River diversion to benefit not only the Mississippi River Delta to the east, but also facilitate sediment transfer to the Cheniers in the west.

It can also be done between individuals and organizations, or between organizations that operate on different scales. The interaction of an individual with the Ag Extension Office, and their assistance in, for example, applying for an EQUIP grant or meeting the state labeling requirements for direct sales of beef, would be multi-scalar organizational collaboration.

How is it beneficial? Multi-scalar collaboration can promote resilience and enhance diversity by combining different types of knowledge. This contributes both to social learning and to balancing power between actors. It does this by stretching civil society relationships over time and space, thereby amplifying the depth of resources available to the various actors. For example: When the VPCA can look to CPRA for support and guidance in coastal restoration project funding, they collaborating across temporal, spatial and organizational scales. By doing this, they are able to increase the quantity and type of assistance available to them, thus enlarging their ability to affect change within the system.

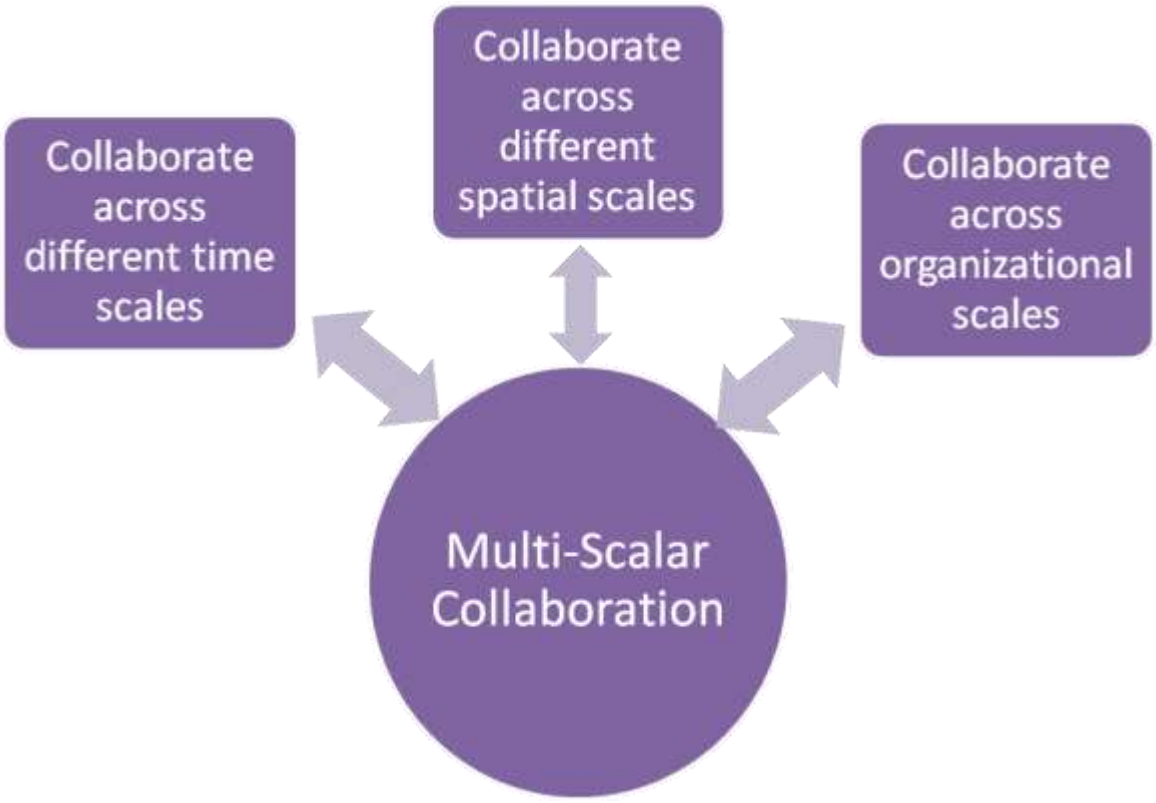

Illustration 4: Multi-Scalar Collaboration

Source: Danica Adams

The following recommendations are an attempt to incorporate these ideas and benefits of multi-scalar collaboration into the fabric of Vermilion Parish cattle ranching.

Recommendation 4: Build Stronger Connections:

An organized group of people can make big things happen. The bulk of the threats that were identified by respondents fell into the Techno-Environmental category. Most cattle ranchers are not in a position to build levees or fill canals by themselves. And, as discussed throughout this thesis, these technological innovations have contributed to the severity of naturally occurring events, such as hurricanes or droughts, making them increasingly relevant to the rancher's ability to make a living. Although

these are technological and environmental problems, the solutions will necessarily be social and political as well as technological and environmental.

Suggestion 4.1: Coalition of Organizations

I suggest building on the strength of the many organizations that are already active in the area: the VPCA, the LSU Agricultural Extension Center, the Acadiana RC&D, the Soil and Water Conservation Board (part of the NRCS), Center for Planning Excellence, the University of Louisiana at Lafayette, and the Coastal Alliance. Building on this strength means that these organizations would expand to include more people and have more conversations about salient issues, and have them more frequently. This would increase the collaboration between organizations. They would also expand their scope to connect with each other, as well as organizations outside of the parish to develop a common understanding of issues. In this way, spatial collaboration is enhanced. These issues may include the science behind coastal restoration projects, the prioritization of those projects, the idea of transitions to grass fed beef programs and what support may be required for that, or the formation of a grass fed beef and marketing cooperative. Temporal collaboration would emerge by working with organizations that operate on a longer or shorter time frame.

There are many specific ways that these organizations could achieve this collaboration. The expansion of VPCA field day events and inclusion of academic or scientific experts in those field days could provide a new perspective.

Presentations to civic organizations about coastal restoration or grass fed beef could increase understanding of local economic development and provide a conversation starter for people outside of the cattle community. These presentations would articulate

ways that they, as consumers or as advocates can have a direct effect on their parish and neighbors.

Suggestion 4.2: Advocate

I suggest using this increased social cohesion to advocate for those issues that are salient to ranching. Highly organized groups that speak for a large number of people will hold greater amounts of political influence than individuals speaking for themselves. When multiple organizations collectively advocate about one or two topics, this targeted lobbying can increase the likelihood that the issue will be addressed. Some issue that may be appropriate to tackle include a small farm bill that would change in slaughterhouse limits on restaurants or the issues surrounding coastal restoration funding.

Recommendation 5: Landuse Issues

Sayre et al state that "Land use change currently poses the greatest threat to rangeland biodiversity." This statement mirrors statements made by some of my interview respondents. Not every respondent identified subdivisions as a significant concern, but in time it could become an increasing threat. Part of the problem is that while ranchers rely on large tracts of land, preferably contiguous tracts, some percentage of that land is often rented from another landowner. If that landowner decides to develop it, then the options for pasture become more constrained. Since development of any kind is difficult, if not impossible to undo, pre-emptive or pro-active steps must be taken.

Suggestion 4.1: Agricultural Land Use Easements

A community of ranchers is dependent on large, contiguous areas of pasture, often owned by multiple landholders, and is described by Sayre at al. with the metaphor of a bundle of sticks. When left intact, this "bundle of sticks" will provide the land necessary for raising cattle. Conservation easements, in which development rights are sold to a land

trust or a government entity, can be one solution to the problem of property subdivisions and development. Although the environmental community has largely embraced this concept, agriculturalists have been slightly more hesitant.

The goal of an agricultural conservation easement is to maintain agricultural land in active production by removing the development pressures from the land. An agricultural easement does not prohibit the buying or selling of property, but the development restrictions remain in effect when the land changes ownership (Land Trust Alliance, n.d.; CA Farmland Conservancy, n.d.; Marin Ag Land Trust, n.d.). One example of a successful Agricultural Land Trust in the San Francisco Bay area is MALT [http://www.malt.org].

Mitigation easements – when landowners sell habitat credits, via a mitigation bank, to public or private developers when they are required to offset damage caused by construction projects elsewhere – are a similar solution. Additionally, a situation that is common in Vermilion Parish due to family inheritance is the idea of shared or common property. In these cases, all of the shareholders must agree to any action having to do with the land (Sayre, et al., 2012).

SUMMARY TABLE OF THREATS, RECOMMENDATIONS, AND SUGGESTIONS

In the previous pages I suggested increasing economic strength through diversification, increasing social learning opportunities, and collaborating across spatial, temporal, and organizational scales. One specific recommendations for how to do this was the diversification of the market, the product, and the marketing strategy for beef producers by encouraging a grass finished beef market in Vermilion Parish. Another suggestion was getting involved in and improving current social learning opportunities. I also suggested reinforcing the culture of cattle ranching through systematically engaging

with youth that might not otherwise have an opportunity to learn how to raise cattle. I also suggested the formation of a civil society agency comprised of individuals and coalitions of organizations that would advocate on the local and state levels for improved conditions. These conditions could include coastal restoration projects or policies and regulations aimed at revising the regulations surrounding locally produced beef. Finally, I suggested the formation of a local agricultural land trust designed to prevent further fragmentation of available pasture.

Each of the above recommendations and suggestions were conceptualized to do one or more of the following, illustrated below.

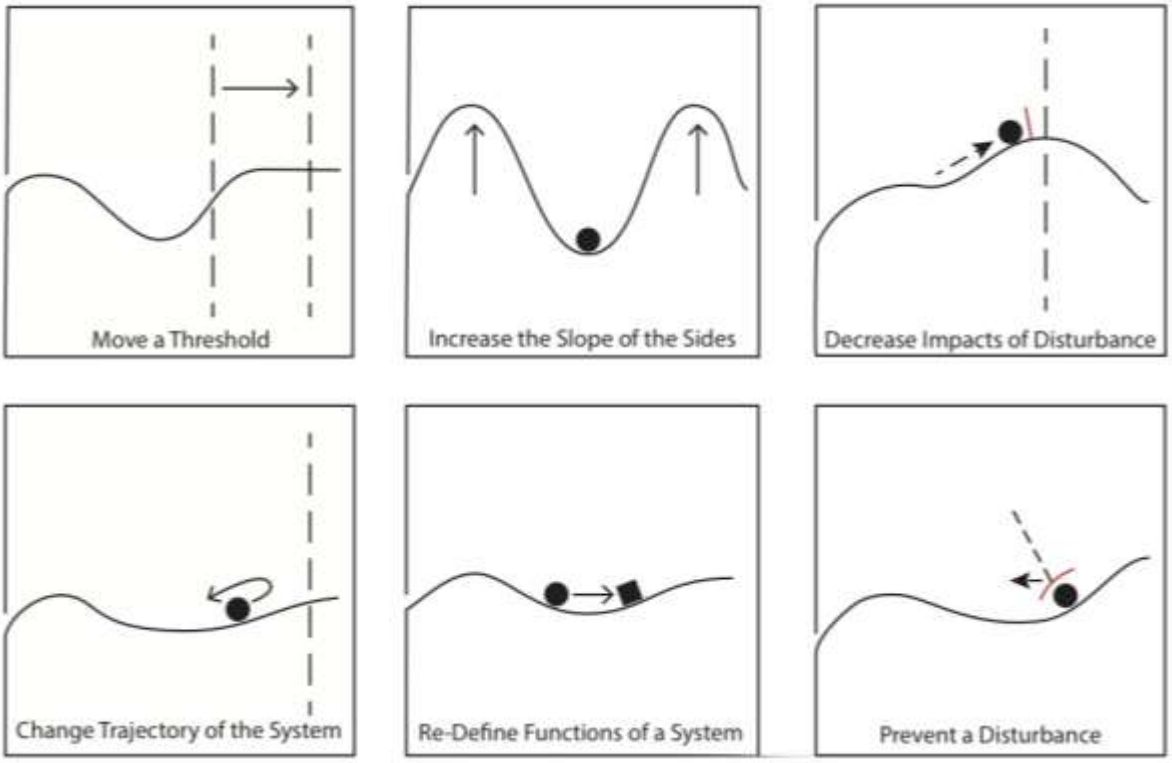

Figure 22: Ways to Increase Adaptive Capacity

Source: Danica Adams

Recommendation	Suggestion	Threats that it addresses	Immediacy of implementation	Who could implement?	Timing: Slow or Fast cycle	Relationship to Theory
1. Economic strength	1.1: Encourage Grass Finished Beef	Next Generation Age Money	0-12 months	VPCA LSU Ag Center	Moderate	Re-defines functions of system Moves a threshold
1. Economic strength	1.2: Mobile Processing Unit	Next Generation Age Money	Immediately	Acadiana RC&D	Fast	Changes trajectory of the system
1. Economic strength	1.3: Cooperative for Marketing and Distribution	Next Generation Age Money	0-12 months	Coalition of Ranchers	Moderate	Changes trajectory of the system
1. Economic strength	1.4: Develop Local Markets	Next Generation Age Money	0-12 months	Coalition of Ranchers	Moderate	Changes trajectory of the system
1. Economic strength	1.5: Improve Equipment Sharing	Next Generation Age Money	As the opportunity presents itself	VPCA	Fast	Changes trajectory of the system Increase Slope of Sides
2. Communication	2.1: Get Involved in Current Efforts	Policy All Techno-Enviro	Immediately	Individuals Police Jury	Slow	Moves a threshold Changes trajectory of the system
2. Communication	2.2: Improve Current Efforts	Policy All Techno-Enviro	0-12 months	Individuals Police Jury	Slow	Moves a threshold Changes trajectory of the system
2. Communication	2.3: Knowledge Sharing	Policy All Techno-Enviro	0-12 months	Individual	Fast	Changes trajectory of the system
3. Reinforce Culture	3.1: Mentor/ Mentee	Next Generation	1-2 years	4-H Club/ VPCA	Moderate	Changes trajectory of the system
3. Reinforce Culture	3.2: New Farmer Incubator	Next Generation	1-2 years	4-H Club/ VPCA	Slow	Changes trajectory of the system
3. Reinforce Culture	3.3: Vermilion Parish Rodeo	Next Generation	2-3 years	4-H Club/ VPCA	Moderate	Changes trajectory of the system
4. Build Stronger Connections	4.1: Coalition of Organization	Policy All Techno-Enviro	0-12 months	Various organizations	Slow	Decreases impacts of a disturbance
4. Build Stronger Connections	4.2: Advocate Together	Policy All Techno-Enviro	1-2 years	Various Organizations	Slow	Helps prevent a disturbance Redefines functions of the system Moves a threshold
5. Landuse	5.1: Land trust	Next Generation Money Subdivisions	3-4 years	New Civil Society Org	Slow	Helps prevent a disturbance Increase Slope of Sides

Table 5: Summary Table of Threats, Recommendations, and Suggestions.

In this table I have linked the recommendations and suggestions to the threats that they address and resilience theory. Source: Danica Adams

These recommendations and suggestions are modular – they would be strongest if implemented in concert with each other, but if implemented separately, they can stand alone. For instance, the suggestion to encourage grassfed beef production can be implemented whether or not Acadiana RC&D ever invests in a mobile processing unit. Additionally, the knowledge sharing that comes with a radio show or newspaper column is beneficial, even if a mentor/mentee program is never launched. I maintain, however, that the result of implementing multiple suggestions is greater than the sum of its parts.

Over the span of this research, I have seen that ranchers themselves value their work as a way of life – a way to be a steward of the land, be their own boss, and work outside. These values represent a willingness to preserve more than just their profit margin. The ranchers that I spoke with are generally willing to take advantage of opportunities that they believe will enhance the ecological processes on which they, their livestock, and range ecosystems as a whole all depend.

FURTHER RESEARCH NEEDED

One shortcoming of this research is the small sample size for interviews and 3CM sessions. Another shortcoming is the lack of feedback from respondents regarding the above-mentioned recommendations and suggestions. This is largely due to time and travel constraints.

I anticipated a greater correlation between geography and perceptions. While this research does support that idea to some degree, better indicators and a larger sample size may reveal a stronger or weaker spatial pattern. I suggest that in order to have a more robust understanding of perceptions, future iterations of this research include more interview and 3CM respondents. Future research should also incorporate original

suggestions from the respondents regarding potential solutions to identified threats. Along this same vein, I recommend that the researcher solicits feedback from each of the respondents regarding the researcher's recommendations and suggestions. In this way, the community may begin to own the ideas. This is often a first step in community organizing.

Future research may expand this topic to include extended spatial analysis. The connection between landcover change, shifts in size and number of cattle producers and specific cultural, technological or ecological events could be an interesting exploration. Additionally, I suggest an explicit timeline that outlines changes in perceptions of natural and technological systems associated with cattle ranching. This may help establish a linkage between time, space, and perceptions.

CONCLUSION

The Cheniers are only 3,000 years old, but people have been in the area for close to 12,000 years. Therefore the Cheniers are an STES – they have never been an untouched landscape. The people that have lived in the marshes have historically either burned or grazed the land. Because fire and grazing can accomplish similar things in an ecosystem, the Cheniers exist in the regime that they do because of their interaction with people, fire, and cattle. Without at least one of those happening regularly, the marsh ecosystem could transition to a totally different ecosystem. Currently, the ranchers are the only ones who graze or burn the marshes. Therefore, I argue that without the ranchers, the Cheniers will cross a threshold and undergo a regime shift into a different ecosystem.

In other words, if people no longer graze or burn the marshes, a different mix of grasses will grow, and therefore a slightly different mix of species that eat that grass

(rabbits, muskrat, beavers) will live. Additionally, trees have a hard time getting established in those ecosystems that are fire or grazing dominated. Without fire or grazing, the grass ecosystem could transition to a tree-dominated ecosystem. This transition would precipitate a shift in the mix of flora and fauna.

Cattle ranching in Vermilion Parish is a social-techno-ecological system that is currently vulnerable due to changing social, technological and ecological conditions. In addressing ways to increase the adaptive capacity of cattle ranching in Vermilion Parish, I used a multiple, mixed method approach grounded in a critical constructivist framework. Constructivism is the idea that our relationship to facts, what they mean to us, and how relevant they are to us, is constructed by our social context. The idea that the meaning of events or objects in our world differs between people is important because it is these perceptions that shape people's actions. For this reason, I studied perceptions. I looked at these perceptions through an emancipatory frame – the "critical" part of critical constructivism. This allowed me to not only understand multiple interpretations of meaning, but to consciously address them, consider how they may have shaped our actions, and then alter those meanings and power relationships. In an effort to increase the adaptive capacity of cattle ranching in Vermilion Parish, my research focused on actions, why people perform those actions, and how to change them.

This research connected the physical landscape of the marshes, the individual landscape of perception, and the conceptual landscape of resilience. If resilience is the ability of a system (cattle ranching in vermilion parish) to recover after a disturbance, adaptive capacity is when the actors within the system can influence that system's resilience. This could mean shifting its trajectory within the basin of attraction or moving the thresholds that separate one stable state from another.

Exploring the history and background of Vermilion Parish from three different, but overlapping perspectives – environmental, social, and technological - allows the exploration of cattle ranching system in vermilion parish as an STES moving through the adaptive cycle. These perspectives compliment the practical and perception information gleaned through interviews and 3CM sessions. These interviews, which were conducted with 15 respondents –all actors in the system, revealed the perception of 11 types of threats facing cattle ranching in Vermilion Parish. Mapping revealed the spatial relationships. The subsequent 3CM sessions allowed complex lines of logic and mental models to come to the surface. Given these layered landscapes and their complexity, my recommendations were subject to feedback loops and long periods of integration.

The body of literature surrounding resilience theory identifies traits of highly adaptive systems. The recommendations and suggestions outlined above exist at the intersection of the actors' perception of specific threats and the decidedly generalized traits of highly adaptive systems. These suggestions were geared towards increasing the adaptive capacity of cattle ranching in Vermilion Parish. These practical and highly concrete recommendations contribute to the theoretical foundation detailed in Chapter 3, and reinforced in Chapter 4 by identifying specific ways that the actors of this particular system may be able increase their own adaptive capacity.

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